
FINAL REPORT
PHILLIPS ISLAND
MARCUS HOOK REFINERY
MARCUS HOOK, PENNSYLVANIA

Act 2 ID# 1-23-825-28219

Prepared for:

Sunoco, Inc. (R&M)

Marcus Hook Facility

100 Green Street

Marcus Hook, Pennsylvania

Prepared by:

URS Corporation

Fort Washington, Pennsylvania

SEPTEMBER 2005

TABLE OF CONTENTS

Executive Summary.....	ES-1
Section 1 Introduction.....	1-1
Section 2 Background.....	2-1
2.1 Site Location	2-1
2.2 Site Description.....	2-1
2.3 Site History	2-2
2.4 Previous Investigations and Remedial Actions.....	2-2
2.5 Site Redevelopment	2-4
2.6 Conceptual Site Model.....	2-4
2.7 Environmental Setting	2-5
Section 3 Site Characterization	3-1
3.1 Geology.....	3-1
3.2 Hydrogeology	3-2
3.2.1 LNAPL Seeps	3-3
3.2.2 Groundwater Flow	3-3
3.2.3 Hydraulic Properties	3-3
3.3 Chemical Characterization.....	3-5
3.3.1 Water.....	3-6
3.3.2 Soil.....	3-8
3.3.3 LNAPL Results.....	3-9
Section 4 Fate and Transport	4-1
4.1 Fate and Transport Analysis	4-1
4.1.1 Model Analysis – First Run	4-2
4.1.2 Model Analysis – Second Run.....	4-3
4.2 Surface Water Impact Assessment.....	4-4
Section 5 Risk Assessment.....	5-1
5.1 Identification of Compounds of Potential Concern	5-1
5.2 Exposure Characterization.....	5-2
5.2.1 Groundwater Ingestion and Dermal Contact	5-2
5.2.2 Groundwater Vapor Inhalation	5-3
5.2.3 Soil Direct Contact.....	5-3
5.2.4 Inhalation of Vapors from Soil	5-3
5.2.5 Surface Water Direct Contact	5-4
5.2.6 LNAPL Direct Contact	5-4
5.2.7 Inhalation of Vapors from LNAPL.....	5-4
5.2.8 Exposure During Construction	5-4
5.2.9 Industrial Worker Exposure.....	5-5

TABLE OF CONTENTS

5.3	Ecological Exposure Characterization.....	5-6
5.3.1	Terrestrial.....	5-6
5.3.2	Shoreline and Adjacent River Area	5-7
5.4	Summary of Potential Exposure Pathway Assessment.....	5-7
Section 6	Remedial Actions.....	6-1
6.1	Remedial Action Implementation	6-1
6.1.1	Passive Vapor Control Beneath Buildings.....	6-1
6.1.2	Enhanced LNAPL Recovery and Seep Control System	6-2
6.1.3	Stained Soil Removal Around The West Seep	6-4
6.1.4	Stormwater Control/Infiltration Minimization	6-5
6.2	Sampling and Analysis	6-5
6.3	List of Contacts	6-6
Section 7	Demonstration of Attainment.....	7-1
7.1	Attainment of Site-Specific Standard	7-1
7.1.1	Soils.....	7-1
7.1.2	Groundwater	7-1
7.2	Demonstration of Attainment Summary.....	7-1
Section 8	Post-Remediation Care Plan	8-1
8.1	Substantive Post-Remediation Care Requirements	8-1
8.2	Notice of Post-Remediation Care Requirements and Deed Acknowledgment	8-1
Section 9	Public Comments.....	9-1
Section 10	Signatures	10-1
Section 11	References	11-1

LIST OF TABLES, FIGURES AND APPENDICES

TABLES

Table 1	Summary of Analytical Program
Table 2	Remediation Standards Attained by Compound
Table 3	Summary of Groundwater Elevations
Table 4A	Summary of Compounds Detected in Groundwater Above the Non-Residential Used Aquifer MSC- February 23-25, 2000
Table 4B	Summary of Compounds Detected in Groundwater Above Non-Residential Used Aquifer MSC April 27, 2000
Table 4C	Summary of Compounds Detected in Soil Pore Water Above the Non-Residential Used Aquifer MSC
Table 5A	Summary of Water Sample Analytical Results February 25, 2000 Groundwater Sampling Round-VOCs
Table 5A	Summary of Water Sample Analytical Results April 27, 2000 Groundwater Sampling Round-VOCs
Table 5A	Summary Water Sample Analytical Results-Soil Pore Water VOCs
Table 5B	Summary of Water Sample Analytical Results February 25, 2000 Groundwater Sampling Round SVOCs
Table 5B	Summary of Water Sample Analytical Results April 27, 2000 Groundwater Sampling Round SVOCs
Table 5B	Summary Water Sample Analytical Results-Soil Pore Water SVOCs
Table 5C	Summary of Water Sample Analytical Results February 25, 2000 Groundwater Sampling Round Pesticides
Table 5D	Summary of Water Sample Analytical Results February 25, 2000 Groundwater Sampling Round –Metals, Inorganics and THP
Table 5D	Summary Water Sample Analytical Results-Soil Pore Water-Metals
Table 6	Summary of Compounds Detected In Surface Soil Above The Soil To Groundwater Pathway MSC
Table 7A	Summary of Surface Soil Sample Analytical Results- VOCs
Table 7B	Summary of Surface Soil Sample Analytical Results- SVOCs
Table 7C	Summary of Surface Soil Sample Analytical Results- Pesticides and PCBs
Table 7C	Summary of Surface Soil Sample Analytical Results- Pesticides
Table 7D	Summary of Surface Soil Sample Analytical Results- Metals and TPH
Table 8	Summary of Compounds Detected In Unsaturated Subsurface Soil Above the Soil to Groundwater Pathway MSC
Table 9A	Summary of Unsaturated Soil Sample Analytical Results- VOCs
Table 9B	Summary of Unsaturated Soil Analytical Results-SVOCs
Table 9C	Summary of Unsaturated Soil Analytical Results-Pesticides and PCBs
Table 9D	Summary of Unsaturated Soil Analytical Results-Metals and TPH
Table 10	Summary of Compounds Detected in Saturated Subsurface Soil Above the Soil to Groundwater Pathway MSC

LIST OF TABLES, FIGURES AND APPENDICES

Table 11A	Summary of Saturated Soil Sample Analytical Results-VOCs
Table 11B	Summary of Saturated Soil Analytical Results-SVOCs
Table 11C	Summary of Saturated Soil Analytical Results-Pesticides and PCBs
Table 11D	Summary of Saturated Soil Sample Analytical Results-Metals and TPH

FIGURES

Figure 1	Site Vicinity Map
Figure 2	Current Site Layout
Figure 3	Former Site Layout
Figure 4	Historic Fill and Shorelines Map
Figure 5	Boring and Well Locations
Figure 6	Site Map Showing Geologic Cross Sections A-A' Through E-E'
Figure 7	Topographic Contours of the Native Sediment Horizon
Figure 8A	Groundwater Elevation Contour Map March 15, 2000
Figure 8B	Groundwater Contour Map April 26, 2000
Figure 9	LNPL Thickness Map February 22-23, 2000
Figure 10A	Groundwater Concentrations Above MSCs February 22-25, 2000
Figure 10 B	Groundwater Concentrations Above MSCs April 27, 2000
Figure 11	Unsaturated Soil Concentrations Above MSCs
Figure 12	Pathway Analysis and Demonstration of Attainment

APPENDICES

Appendix A	Communication With PADEP
Appendix B	Final Report Summary
Appendix C	Soil Boring Logs & Well construction Details
Appendix D	Fate & Transport Model Results - First Run
Appendix E	Fate & Transport Model Results - Second Run
Appendix F	Construction Worker Exposure Calculations
Appendix G	Industrial Worker Exposure Calculations
Appendix H	Passive Vapor Control System
Appendix I	Sheet Pile Barrier Wall
Appendix J	LNAPL Control and Recovery System
Appendix K	Stormwater Control System
Appendix L	Grantee's Amendment to Deed

Sunoco, Inc. (R&M) (Sunoco) retained URS Corporation (URS) to assist Sunoco in implementing remedial work pursuant to Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) 35 P. S. § 6026.101 et seq., and the regulations promulgated by the Pennsylvania Department of Environmental Protection at 25 Pa Code Chapter 250 ("Act 2 regulations") pertaining to the Administration of the Land Recycling Program, for a portion of their Marcus Hook, Pennsylvania refinery referred to as Phillips Island. Upon attainment of an Act 2 Standard, Cleanup Liability Protection is afforded pursuant to Chapter 5 of Act 2. Sunoco conducted Act 2 remedial work in connection with agreements with FPL Energy Marcus Hook, L. P. ("FPLE") under which FPLE constructed a Co-generation plant, and new standby refinery boilers at the Marcus Hook Refinery. The Co-generation facility was constructed on 21.1 acres of Phillips Island which is approximately 27 acres in size. The Pennsylvania and Delaware state border passes through the site. Of the 21.1 acres, approximately 4 acres are located in Delaware.

FPLE's Co-generation facility is fueled with natural gas and is designed to produce 750-megawatts of electricity per day. FPLE has also constructed new standby boilers for use by the refinery that are also fueled with natural gas.

The initial phase of the Act 2 remedial work included a site characterization, remedial investigation, risk assessment, development of appropriate remedial alternatives, and preparation of a cleanup plan. The scope of these tasks was consistent with Act 2 and Act 2 regulations. The remedial work was conducted in the second phase and is comprised of engineering controls for pathway elimination. As indicated in this Report, Sunoco has achieved either the Statewide Health Standards in Act 2, or a Site-specific Standard under Act 2 using engineering controls for pathway elimination. Engineering controls used at Phillips Island included the following:

- Passive vapor control beneath occupied co-generation plant buildings;
- Enhanced LNAPL recovery and seepage elimination with a barrier;
- Removal of impacted soil from around the seep near the top of the west bank of the berm; and
- Stormwater control and infiltration minimization.

The results of the initial phase of the Act 2 program were presented in a report titled Act 2 Combined Report – Revision 1 dated July 14, 2000 (July 2000 Combined Report).

Analytical results from the remedial investigation were compared to the statewide health standard soil to groundwater pathway and direct contact exposure medium-specific concentrations (MSCs) to identify chemicals of potential concern (COPCs). The analytical results indicate that many of the regulated substances are below the medium-specific concentrations and accordingly meet the statewide health standards.

For surface and subsurface soils, the detection limits for several of the semi-volatile organic compounds (SVOCs) were above either the non-residential used aquifer soil to groundwater pathway MSCs or the surface and subsurface direct contact MSCs. To assess the potential for these compounds to be present above the MSCs, they were included in the exposure characterization. A Site-specific Standard was achieved for these compounds using engineering controls for pathway elimination.

Evaluation of the potential exposure pathways under current and future use scenarios concluded the following:

- There are no potable wells in use at or downgradient of the site. Groundwater ingestion and groundwater dermal contact are not complete exposure routes of concern. Occupied co-generation plant buildings include a passive vapor control system, thereby eliminating the potential for worker exposure inside buildings. This engineering control eliminates the groundwater vapor inhalation exposure pathway.
- The potential soil exposure pathway for workers on Phillips Island is through direct contact. However, the site has been covered with asphalt and clean gravel to eliminate the potential soil direct contact exposure scenario. Under the current use scenario, the soil direct contact pathway has been eliminated utilizing these engineering controls for pathway elimination. The addition of asphalt and clean gravel surfaces (engineering controls) at the site are also utilized to control and collect stormwater and prevent stormwater contact with site soils.
- Model results indicate that surface water quality standards will not be exceeded. Therefore, surface water direct contact with dissolved compounds is not an exposure pathway of concern.
- In the light non-aqueous phase liquid (LNAPL) sample, only one COPC was detected and at a concentration below the non-residential used aquifer soil to groundwater pathway MSC (used for screening purposes). Though the chemical composition of the LNAPL does not pose a threat to human health or the environment, the physical discharge of the LNAPL is considered a potentially complete pathway. Therefore, a sheet pile barrier wall was installed to prevent possible further seepage to the River.
- The evaluation of ecological receptors indicated there is a lack of complete exposure pathways.

Based on the results of the remedial investigation and risk evaluation, remedial actions were developed for the site and included in the cleanup plan. Following PADEP approval of the proposed remedial actions, Sunoco and FPLE constructed the remedial systems in conjunction with the co-generation plant site redevelopment. Major components of the overall remedy for the site include:

1. Enhanced LNAPL recovery and seepage elimination with a barrier wall.
2. Removal of impacted soil from around the seep near the top of the west bank of the berm (completed as part of the barrier wall installation).
3. Passive vapor control beneath occupied co-generation plant buildings.
4. Stormwater control and infiltration minimization.

The enhanced LNAPL recovery system includes a series of new recovery wells in the berm along the bank of the Delaware River. To eliminate seeps, a sheet pile barrier wall was placed in the area of the seeps along a portion of the western bank of Phillips Island. LNAPL adjacent to the barrier is being removed with the enhanced recovery system. Interim measures, consisting of a floating boom and absorbent in the area of the seeps, are maintained to prevent the migration of LNAPL to the river. The boom was maintained during the installation of the barrier wall and

maintenance will continue after LNAPL residuals riverside of the barrier wall have dissipated. Impacted soil around the seep near the top of the west bank of the berm was removed to eliminate the direct contact exposure pathway.

The co-generation plant was designed and constructed to eliminate potential exposure routes of constituents of concern resulting from historic land uses. Mechanisms for pathway elimination include a vapor control system beneath all buildings occupied by workers. The ground surface has been covered with either gravel or asphalt to remove the potential for worker and ecological receptor direct contact with surface soil. Stormwater is collected by overland flow and subsurface drains and channeled to the plant cooling towers which minimizes both the infiltration rate to the subsurface and the use of potable water for non-contact cooling.

Construction and ongoing operation of these measures has eliminated exposure pathways (direct contact and inhalation) and mitigate potential migration of compounds detected at the site.

Since the startup of the enhanced LNAPL recovery system in March 2004, Sunoco has recovered a total of approximately 3,900 gallons of LNAPL (as of the end of November 2004). This represents a recovery rate of approximately 400 gallons of LNAPL per month. In addition, the seeps once present along the west berm have ceased. This data indicates that the remedial actions implemented at the site are attaining the objectives of eliminating potential exposure pathways, control of LNAPL and groundwater migration, and improvements to subsurface conditions. Therefore, the remedial work has achieved Site-specific Standards under Act 2 using engineering controls for pathway elimination.

Sunoco, Inc. (R&M) (Sunoco) retained URS Corporation (URS) to assist Sunoco in implementing remedial work pursuant to Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) 35 P. S. § 6026.101 et seq., and the regulations promulgated by the Pennsylvania Department of Environmental Protection at 25 Pa Code Chapter 250 ("Act 2 regulations") pertaining to the Administration of the Land Recycling Program, for a portion of their Marcus Hook, Pennsylvania refinery referred to as the Phillips Island site ("Phillips Island"). Upon attainment of an Act 2 Standard, Cleanup Liability Protection is afforded pursuant to Chapter 5 of Act 2.

The initial phase of the Act 2 remedial work included a site characterization, remedial investigation, risk assessment, development of appropriate remedial alternatives, and preparation of a cleanup plan. The scope of these tasks was consistent with Act 2 and Act 2 regulations. The purpose of the remedial investigation was to characterize site environmental conditions and obtain information for assessing the potential risk to human health and the environment. A summary of the analytical program is provided in Table 1. The results of implementing the initial phase of the Act 2 program demonstrated the site would meet Act 2 requirements for closure under site-specific standards using engineering controls for pathway elimination. The results of the initial phase of the Act 2 program were presented in the July 2000 Combined Report.

In a letter dated August 16, 2000 (Appendix A), the Pennsylvania Department of Environmental Protection (PADEP) approved the July 2000 Combined Report and agreed with Sunoco that existing environmental conditions at the site are within acceptable risk ranges. In the letter, PADEP requested that additional site improvements, including institutional and engineering controls to eliminate the direct contact exposure pathway (via control and elimination of seeps and control of stormwater infiltration) and vapor migration pathway, be documented in the final report to demonstrate attainment of the Act 2 Site-Specific Standard based on Elimination of Pathway.

The remedial work was conducted in the second phase and is comprised of engineering controls for pathway elimination. Sunoco has achieved either the Statewide Health Standards in Act 2, or a Site-specific Standard under Act 2 using engineering controls for pathway elimination.

On behalf of Sunoco, URS has prepared this *Final Report* for the Phillips Island site as requested by PADEP and in accordance with the requirements established under Act 2.

This report demonstrates that the Site-Specific Standard (SSS) based on Elimination of Pathway or the Statewide Health Standards have been attained for all site constituents of potential concern (COPCs) in all site media (Table 2).

In compliance with applicable Act 2 requirements, this *Final Report* includes a Post-Remediation Care Plan for the engineering controls necessary to maintain incomplete exposure pathways for the Site. The engineering controls consist of the following:

1. Enhanced LNAPL recovery and seepage elimination with a barrier wall
2. Passive vapor control beneath occupied co-generation plant buildings

3. Stormwater control and infiltration minimization

Sunoco will prepare and incorporate into the property deed, the required Act 2 deed acknowledgements/restriction to maintain the Site-Specific Standard and prevent development of complete exposure pathways.

The Act 2 Final Report Summary Form is included as Appendix B.

2.1 SITE LOCATION

The Phillips Island site is located in the southwest section of the Sunoco Marcus Hook refinery. The address of the refinery is 100 Green Street in Marcus Hook, Delaware County, Pennsylvania. Figure 1 is a site location map.

2.2 SITE DESCRIPTION

Phillips Island is an area of approximately 27 acres. FPLE constructed a co-generation facility on 21.1 acres of Phillips Island. Phillips Island in this report is restricted to those 21.1 acres. The Pennsylvania and Delaware state border passes through the site. Of the 21.1 acres, approximately 4 acres are located in Delaware.

Phillips Island extends north to stormwater aboveground storage tank (AST) T-101, a PECO electrical substation, and wastewater AST TK-131, south to the Delaware River, west to the Ethylene Complex, and east to Blueball Avenue. Currently, Phillips Island resembles a small peninsula. In the past, Phillips Island was detached from the main shoreline. The channel separating Phillips Island from the shore was gradually filled.

Phillips Island surface is covered by gravel, asphalt, and co-generation plant buildings/structures. The surface is relatively flat with minor surface topographic expressions. Along the southern property boundary, Phillips Island slopes steeply to the Delaware River. The slope is covered with concrete riprap to prevent erosion. An access road surrounds the southern perimeter of Phillips Island. There are several groundwater monitoring and LNAPL recovery wells around Phillips Island perimeter.

Surface features prior to the site redevelopment (co-generation plant construction) included two ASTs, a roll-off container staging area, a fire-fighting training area, and a sandblasting area. All of these features were removed as part of the co-generation plant construction.

The ASTs included a 1,000-gallon propane AST and a 500-gallon AST for containing LNAPL recovered from wells. Based on the files at the refinery, there is no history of releases from these ASTs nor was staining observed in their vicinity during the Phase I Environmental Site Assessment (ESA).

The roll-off container staging area was used to store empty containers and stage full containers for shipment off-site. The staging area was unpaved; minor soil staining was observed during the Phase I ESA. The roll-off staging area had been in operation since 1970.

The fire-fighting training area (the Training Area) included a tanker truck and two open-top ASTs. The ground surface was concrete-paved and gravel. The training exercises involved placing a small amount of oil on a layer of water in the tanker truck and ASTs and igniting the oil. The Training Area was constructed in 1996. Before 1996, the Training Area was located near the present location of the substation immediately north of Phillips Island. During the Phase I ESA, URS observed minor staining on the ground surface.

Figure 2 is a site layout showing the pertinent features of Phillips Island following the co-generation plant construction. Figure 3 is the former site layout prior to the co-generation plant construction.

2.3 SITE HISTORY

The following paragraphs describe the history of Phillips Island as presented in an internal Sun memorandum, dated January 13, 1992.

Up until the 1930's, Phillips Island was part of a quarantine station for ships steaming up the Delaware River into Philadelphia. Between the 1930's and the early 1940's, the Phillips family owned Phillips Island. Sunoco first came into possession of Phillips Island in the 1940's when Sunoco purchased it from the Phillips'. Shortly thereafter, Sunoco began fill operations on Phillips Island⁽¹⁾.

Following the purchase of Phillips Island, Sunoco installed a stone bulkhead between the mainland and Phillips Island. Between 1941 and 1950, iron pyrites were deposited to the southwest of Phillips Island. Between 1950 and 1960 spent filter clay, catalyst fines, and rubble were deposited in this area. Some small areas were used to weather leaded tank bottoms. Figure 4 shows the location of the bulkhead and the extent of the fill⁽¹⁾.

In approximately 1960, a second bulkhead was installed. This area was filled between 1960 and 1965, predominantly with spent filter clay with some API separator sludge and demolition debris (Figure 4). The filter clays were used to de-wax certain refined lubricating oils. The spent clays were mixed with clean clays and placed and compacted on Phillips Island⁽¹⁾.

In 1965 and 1966, a clay dike was installed at the present extent of Phillips Island. The dike location is shown in Figure 4. The dike is approximately 30 feet wide at its base and 20 feet wide at the crest. The dike is approximately 12 to 15 feet above the mean low water level. The face along the Delaware River is covered with 18 inches of rubble to prevent erosion. Spent filter clay was used to fill the area behind the dike⁽¹⁾.

The fill operations ceased in 1980. In 1985 and 1986, a portion of the site was brought up to grade using between 9,000 and 18,000 tons of fill consisting of 50 percent soil and 50 percent fly ash. The ash was from the Delaware County Regional Authority (DELCORA) incinerator. The former fill area was covered with 1 to 3 feet of fill and soil from the construction of new stormwater tanks in 1992.

2.4 PREVIOUS INVESTIGATIONS AND REMEDIAL ACTIONS

In 1987, NUS, on behalf of the USEPA, performed a Preliminary Assessment (PA) of Phillips Island⁽²⁾. The PA consisted of a site visit; environmental samples were not collected for laboratory analysis. The findings of the PA were:

- There are no home wells within a three-mile radius of the site;
- There are no public water supply intakes within three miles of the site;

- Land use immediately surrounding the site is industrial; and
- There are no critical environments within a three-mile radius of the site.

In 1990, Sunoco retained ERM, Inc. to perform a subsurface investigation and screening study of Phillips Island^(3,4). The ERM, Inc. screening report⁽³⁾ concluded that capping Phillips Island to prevent infiltration coupled with a containment remedy appeared to be the most feasible alternative.

The ERM subsurface investigation included 12 hand-auger borings, three (3) soil borings, and eight (8) test pits⁽⁴⁾. A total of 22 soil samples were collected. The results indicated the presence of petroleum-related volatile organic compounds (VOCs), primarily benzene, toluene, ethylbenzene, and xylenes (BTEX), at concentrations generally below one milligram per kilogram (mg/kg). One soil sample contained ethylbenzene, toluene, and xylenes at concentrations of 11 mg/kg, 31 mg/kg, and 79 mg/kg, respectively. Detected semi-volatile organic compounds (SVOCs) were primarily polynuclear aromatic hydrocarbons (PAHs) at concentrations ranging from less than 1 to 100 mg/kg with one sample containing concentrations up to approximately 1,000 mg/kg. Two pesticides were detected, alpha-BHC and 4,4'-DDD; the concentrations were generally less than 0.5 mg/kg. However, one sample contained 4,4'-DDD at a concentration of 30 mg/kg. Fifteen metals were detected in the samples. The concentrations ranged between 0.6 mg/kg for mercury and 1,566 mg/kg for zinc. Total petroleum hydrocarbon (TPH) concentrations ranged from 17,300 mg/kg to 392,400 mg/kg.

In 1991 A.T. Kearney, Inc., on behalf of the USEPA, performed a Phase II Final RCRA Facility Assessment (RFA) of the Marcus Hook Refinery (including Phillips Island⁽⁵⁾). In general, the RFA identified soil staining on Phillips Island in the areas associated with surface features (e.g., the Training Area, roll-off staging area). The RFA did not identify obvious impacts from the former fill area, specifically noting a lack of seeps along the river. The RFA did recommend a subsurface investigation because the former fill area is unlined.

In 1994, Sunoco submitted a Comprehensive Remedial Plan (CRP) for the Marcus Hook refinery to the Pennsylvania Department of Environmental Resources (PADEP). The CRP was modified in May 1995 (CRP Addendum) to address PADEP comments⁽⁶⁾. The CRP Addendum included verifying the occurrence of LNAPL at Phillips Island.

In 1995, Sunoco retained Groundwater & Environmental Services, Inc. (GES) to assess groundwater along the perimeter of the refinery^(7,8). The GES investigations included installing monitoring wells, 10 soil borings, and monitoring liquid levels in the borings and wells. The borings and wells were completed in fill and waste at a depth of approximately 30 feet; soil and groundwater samples were not collected. The GES investigation results indicated the presence of LNAPL at thicknesses of 0.34 to 14.03 feet. The liquid level monitoring program did not detect any influence from the tidal cycles in the Delaware River. The liquid levels measured in the wells in the waste were anomalous relative to each other and precluded groundwater gradient interpretation⁽⁸⁾. GES also concluded there is little hydraulic communication between groundwater in the former fill area and the Delaware River⁽⁸⁾.

In 1996, Sunoco submitted a CRP for Phillips Island to PADEP⁽⁹⁾. The plan specified LNAPL removal every two weeks via vacuum truck and installation of a LNAPL recovery pump in one

well. PADEP approved the plan in 1996 with the condition that additional investigation of the impact of LNAPL on the river be performed⁽¹⁰⁾. In the third quarter 1996 report, Sunoco responded that at all tidal levels, no seeps of LNAPL were observed along the perimeter of Phillips Island⁽¹¹⁾.

Since 1995, Sunoco has monitored groundwater quality in the refinery perimeter wells on an annual basis in accordance with the CRP. One of the wells (MW-118) is located on Phillips Island. This well originally contained three (3) feet of LNAPL. The analytical results for well MW-118 indicate the historical presence of benzene (from not detected up to 140 micrograms per liter [ug/l]), ethylbenzene (from not detected up to 2 ug/l), and bis (2-ethylhexyl) phthalate (from not detected up to 10 ug/l). In the 1999 CRP sample from MW-118, no analytes were detected above the detection limit (10 ug/l)⁽¹²⁾.

2.5 SITE REDEVELOPMENT

The new co-generation plant uses natural gas and refinery gas as a fuel source to produce 750-megawatts of electricity per day. FPLE has also constructed new standby boilers for use by the refinery that are also fueled with natural gas. This has resulted in a reduction in the number of older boilers in use at the refinery. The plant has also increased available power for the local electricity grid.

To address potential exposures to constituents of concern at the site, the co-generation plant was designed and constructed with several engineering controls that eliminate potential exposure routes. These include a vapor control system beneath all buildings occupied by workers and a ground surface cover of either gravel or asphalt to prevent worker and ecological receptor direct contact with surface soil or vapors emanating from the subsurface.

A major component of the co-generation plant design includes stormwater control and re-use. Stormwater is collected by overland flow and subsurface drains and is channeled to the plant cooling towers. This process minimizes the potential for stormwater infiltration of subsurface soils and also reduces the use of potable water for non-contact cooling.

2.6 CONCEPTUAL SITE MODEL

The conceptual site model, based on the information from the background investigations, is as follows:

The physical characteristics of the site include a clay berm along the Delaware River; fill materials consisting of process wastes such as filter clay (composed of bentonite clay) and leaded sludge; rubble; demolition debris; and general refuse. The berm is covered with concrete riprap to prevent erosion.

1. The site is covered with a layer of clean soil, asphalt, and gravel.
2. The waste and fill materials contain petroleum-related compounds.
3. Compounds expected in site soil include VOCs, PAHs, and metals.

4. LNAPL is present in wells completed within the waste material in the former fill area.
5. Groundwater occurs in the natural sediments underlying the site.
6. The presence of various types of fill materials, berms, subsurface barriers, native soils, tidally influenced surface waters, and pumping wells combine to make the hydrology of the site complex.
7. Groundwater quality data does not indicate significant quantities of dissolved compounds.
8. The filter clay has a high moisture content. Wells screened in the filter clay tend to act as sumps and accumulate soil moisture and LNAPL from the surrounding filter clay.
9. The low permeability of the filter clay and the berm has isolated the waste and fill from the surrounding environment.

2.7 ENVIRONMENTAL SETTING

The Phillips Island site is located in the southwest section of the Sunoco Marcus Hook refinery. Phillips Island is approximately 21.1 acres and resembles a small peninsula. The site surface is generally flat with small topographic features and a raised area to the south that slopes steeply to the Delaware River. The slope is covered with concrete riprap to prevent erosion and the slope is terraced for an access road that surrounds the southern perimeter of Phillips Island.

Historically, waste, including filter clay, was placed in the former fill area; fill was placed over other areas of Phillips Island. The current edge of the former fill area consists of a clay berm covered with concrete riprap. The surface of the former fill area is covered with asphalt and gravel. Areas currently associated with refinery operations are covered with a concrete slab or gravel.

On the western face of the former fill area berm, near the high water line, seeps of petroleum were present prior to implementing remedial actions. The seeps impacted the rocks, stones, and soil of the adjacent shoreline. The seeps were confined to an approximately 150 foot section of the over 2,000 feet of shoreline of Phillips Island. The seeps appeared to have been associated with discrete layers of material slightly coarser than the clay berm. Minor areas of stressed vegetation (approximately 3 to 10 feet wide and less than a foot thick) and staining was observed at these seeps.

Another seep was located on the western face of the former fill area, approximately 10 feet down from the face and approximately 12 feet above the river water line. The seep encompassed an area of stressed vegetation of approximately 10 feet by 10 feet. Other than the stressed vegetation at the seep, no other areas of stressed vegetation were observed near this area. The area was equipped with an oil recovery system that periodically pumped the oil into a storage tank. The oil was removed from the tank on an as-needed basis.

3.1 GEOLOGY

According to geologic mapping performed by the Pennsylvania Geological Survey (1981), the site is underlain by the Quaternary-age Trenton Gravel Formation. The Trenton Gravel Formation is described as gray or reddish brown gravelly sand with cross-bedded sand and clay-silt beds. Bedrock was not encountered during the soil-boring program but based on the Pennsylvania geologic survey map, the bedrock is believed to be anorthosite, a plagioclase feldspar (anorthite)-rich gabbro and associated contact metamorphic rocks. Geotechnical borings completed at Phillips Island by Black & Veatch in February 2000 as part of the design of the co-generation plant encountered anorthosite bedrock at depths of 35 to 80 feet indicating the bedrock surface depth is highly variable across the site, but generally slopes down to the east.

To assist in evaluating geologic conditions at the site, URS reviewed the logs of borings drilled at the site and supervised the drilling of 9 Geoprobe® borings (GP-PH1 through GP-PH7, B-PH2, and B-PH5) and 20 hollow-stem auger borings (MW-137 through MW-146, B-PH1, B-PH3, B-PH4, and B-PH6 through B-PH12). The boring logs are included in Appendix C. The locations of the borings are shown on Figure 5. Three distinct geologic units (fill, waste, and sediments) are present in the subsurface at the site to a depth of 50 feet bgs and are described below. Figure 6 presents geologic cross sections for the site. The subsurface materials consist of the following three primary units: which are described below:

- Fill material;
- Waste materials; and
- Native unconsolidated materials.

The uppermost unit present at the site is composed primarily of fill consisting of a brown silt or clay with aggregate, brick fragments, and concrete rubble and soil from the 1992 construction of the new stormwater tanks. The fill unit generally extends from near the ground surface to an approximate depth of 5 to 18 feet bgs and is laterally contiguous across the site. Two feet of clean fill was placed at ground surface during construction of the co-generation facility

Borings drilled in the areas of the clay berms encountered dark gray clay from approximately 3 feet bgs to the top of the native sediments. The clay appeared compact and dense.

The waste materials encountered within the former fill area of the site consist primarily of dense gray clay from refinery filtering operations at the site. Other waste materials included construction and demolition debris, glass, gravel, wood, and metal fragments. The waste has discrete and discontinuous zones with high soil moisture and LNAPL content. The boring logs indicate variability in moisture content with depth, alternating in some borings from moist to wet to moist conditions. The wells installed in the waste material in 1995 by GES act as accumulation sumps for the soil moisture and LNAPL. The volumes of liquids in each well are dependent on the depth and the zone penetrated and results in apparent liquid elevations that are variable within short distances. Three borings that were targeted for completion in native sediments were terminated before native sediments were encountered due to LNAPL rapidly filling the boreholes. The waste materials unit generally extends from the base of the fill material unit to an approximate depth of 42 feet bgs. The waste is laterally discontinuous to the

west of the former fill area. The fill unit occurs at the same elevations as the waste in the eastern portion of the site. The waste thickness in the eastern portion of the site is approximately 10 feet. The waste is also discontinuous to the north of the former fill area.

The native materials encountered at the site consisted primarily of gray silty clay. Some areas of the site further away from the Delaware River also contained beds of orange brown sand and gravel. The materials present near the river are consistent with Delaware River fluvial deposits. The materials present further away from the river are consistent with the Trenton Gravel Formation.

Figure 7 is a contour map showing the elevation of the top of the natural soil horizon. From the contours it appears that the original shoreline was oriented east to west in the approximate center of the site. The contours also indicate a possible channel oriented approximately north/south in the vicinity of Blueball Avenue. The slope on the southern end of this channel flattens out indicating a small delta deposit. The sediments encountered in these areas are consistent with this interpretation. The sediments at location MW-140 and B-PH7 contain varying amounts of silty clay and sand and gravel (likely channel deposits in a tidal stream). At GP-PH4 and MW-142 the sediments are mostly clayey silt with lesser amounts of sand and gravel.

3.2 HYDROGEOLOGY

URS installed ten groundwater-monitoring wells (MW-137 through MW-146) at the site in February 2000. The locations of these monitoring wells are shown on Figure 5. Construction details for all of the monitoring wells at the site are presented in Appendix C. Groundwater elevation measurements are summarized in Table 3. Groundwater elevation contour maps are presented as Figure 8a (March 15, 2000) and Figure 8b (April 26, 2000).

The groundwater measurements from previously installed wells MW-113 through MW-119, MW-121, and MW-121A, which are screened within the fill and waste, were not used to generate the contour map from March 15, 2000 since the water levels measured within the filter clay-rich waste appear to be anomalous. Groundwater in these wells occurs at erratic depths that do not correlate with each other or the newly installed wells. The water levels do not appear to be connected to the indigenous sediments underlying the waste. The previously installed wells were screened from 5 feet bgs to 30 feet bgs and they are completed within the fill and waste materials at the site. The wells act as sumps for the soil moisture. Thus, the amount of water accumulated in the wells is in direct correlation to the penetrated zones.

The groundwater level elevations from the monitoring wells in the indigenous sediments were above the top of the sediment horizon indicating that groundwater occurs under semi-confined conditions within the unconsolidated materials above bedrock.

LNAPL was detected in monitoring wells MW-113, MW-114, MW-115, MW-116, MW-117, MW-119, MW-121, and MW-121A during groundwater level measurements that were obtained on February 22 (Figure 9) and March 15, 2000. The groundwater elevations for the monitoring wells containing LNAPL presented on Table 3 were corrected for the presence of LNAPL based on the specific gravity of the LNAPL sample collected from each well. The LNAPL thickness in monitoring wells on March 15, 2000 ranged from 0.07 feet in MW-114 to 6.35 feet in MW-119.

3.2.1 LNAPL SEEPS

LNAPL occurred at seeps along the western bank of Phillips Island. One seep was located approximately 10 feet down the bank slope and the LNAPL was recovered using an LNAPL recovery system.

Seeps of petroleum were also present on the western face of the former fill area berm, near the high water line. The area of seeps was limited to an approximately 150 foot section of the over 2,000 feet of shoreline of Phillips Island. The seeps appeared to be associated with discrete layers of material slightly coarser than the clay berm. Minor areas of stressed vegetation (approximately 3 to 10 feet wide and less than a foot thick) and staining were observed at these seeps. The rocks, stones and soil on the tidal flats beneath the seeps were stained with petroleum from the seeps.

3.2.2 GROUNDWATER FLOW

The groundwater level measurements from the monitoring wells at the site indicate groundwater flows to the south toward the Delaware River, which is consistent with the hydrogeology of the area. The groundwater elevation at MW-146 (near the river) is higher than the surrounding area and likely is due to a mounding effect caused by the bulkhead along the Delaware River. The estimated average hydraulic gradient at the site is 0.0225.

Tidal influences were observed in wells MW-138, MW-140, MW-145, and MW-146. The water table variance due to tides ranged from 0.05 feet in MW-140 to 0.29 feet in MW-146. In general, there appears to be a greater tidal influence in the wells screened in coarser grained materials.

3.2.3 HYDRAULIC PROPERTIES

3.2.3.1 Hydraulic Conductivity

Slug testing was performed on wells MW-138, MW-140, MW-141, MW-144, MW-145, and MW-146. The estimated hydraulic conductivity varies widely, as expected from the variations in the native materials at the site. The hydraulic conductivities observed from slug tests varied with the materials the wells were screened in as follows:

Wells screened in silty clay units had hydraulic conductivities ranging from 0.01103 ft/day in MW-141 to 0.03478 ft/day in MW-144 with an average hydraulic conductivity of 0.02291 ft/day.

Wells screened in sediments containing silty clay and sand and gravel ranged from 0.5634 ft/day in MW-146 to 12.83 ft/day in MW-140.

The hydraulic conductivity values estimated for the materials at the site are consistent with published values for those materials⁽¹³⁾.

The results of the geotechnical analyses were utilized to calculate the horizontal and vertical hydraulic conductivity of the fill and waste materials at the site. The horizontal hydraulic

conductivities ranged from 4.9×10^{-8} cm/sec (GT-5) to 3.1×10^{-5} cm/sec (GT-4). The vertical hydraulic conductivities ranged from 2.9×10^{-8} cm/sec (GT-1) to 2.9×10^{-7} cm/sec (GT-5). The conductivity of the waste filter clay (GT-4 and GT-5) and the clay berms (GT-1 and GT-3) were similar.

3.2.3.2 Drawdown and Yield Calculations

URS performed a drawdown test on wells MW-115, MW-116, and MW-117 to assess the potential long-term drawdown. The test included installing three piezometers, each located approximately 5 to 6 feet from each of the wells being tested. Boring logs for the piezometers are presented in Appendix C. The test was monitored by data loggers connected to pressure transducers placed in the newly installed piezometers to monitor the water level. The wells were pumped until the well was completely dewatered and then intermittently over a three-day period to maintain the dewatering; the very low hydraulic conductivity at the site did not allow the wells to be pumped constantly.

Shelby tube samples of the fill material and possible bulkhead material were collected at four locations for triaxial permeability testing, oil and water content, and grain size. The transmissivity (T) at each location was calculated from the equation:

$$T = Kb$$

Where K = horizontal permeability
b = saturated thickness

The estimated yield at each location was obtained by the equation:

$$T = 2000 C_s$$

Where T = transmissivity in gal/day/ft
 C_s = specific capacity in gal/min/ft
Yield = C_s x saturated thickness in feet

From the Theis equation, the radius of influence at each location was calculated. The conservative assumptions used were:

- Pumping for 10 days (assumes a significant precipitation event an average of every 10 days)
- Specific yield = 0.05 (S)
- Drawdown at radius of influence = 0.01 foot

The results are:

Location	Saturated Thickness (feet)	Max. Pumping Rate (gpm) for 10 days	T (gpd/ft)	S	Radius of Influence (feet)
GT-1 (MW-141)	8	0.00014	0.034	0.05	0.15
GT-3 (MW-143)	30	0.003	0.19	0.05	8.7
GT-4 (MW-145)	18	0.1	11.4	0.05	62
GT-5 (B-PH-7)	30	0.000016	0.0318	0.05	2.0

3.2.3.3 Drawdown Testing

The results of the drawdown test were inconclusive. The water levels in the piezometers were constantly rising during the period of the testing, which masked the drawdown from the pumping of the nearby well. The cause of the water level recovery may be a delayed response to the bi-weekly evacuation of the LNAPL recovery wells or the water levels were still recovering to static levels following disturbance during piezometer installation. The very low hydraulic conductivity at the site results in a slow recovery rate. Based on these data and observations during the drawdown test, it will take greater than three days to establish the zone of influence around a recovery well. Once that zone is established, though, it can be maintained at low pumping rates.

3.3 CHEMICAL CHARACTERIZATION

The following sections discuss the chemical characteristics at the site relative to applicable cleanup standards. Summary tables are presented as Tables 4 through 11.

The QC samples included trip blanks, equipment blanks, field blanks, duplicates, matrix spike (MS) and matrix spike duplicates (MSD). Dichloromethane was detected in all of the trip, equipment, and field blanks with a concentration range from 0.6 to 10 ug/l. Bis(2-ethylhexyl)phthalate was detected in one equipment blank at a concentration of 40 ug/l. Minor detections of acetone, arsenic, and mercury were reported in equipment or field blanks.

The analytical data was compared to the Act 2 statewide non-residential used aquifer and non-residential health standards MSCs. The statewide MSCs were used to identify constituents of concern for developing site-specific MSCs. Tables 4, 6, 8, and 10 summarize the number of detections above the statewide MSCs, the minimum and maximum concentrations detected, and the calculated median and mean of the detected concentrations above MSCs. Table 2 lists the compounds in soil and groundwater that achieve the statewide MSCs. Accordingly, for these compounds, the applicable Act 2 standard will be the statewide non-residential used aquifer and non-residential health standards rather than site-specific standards.

The results of the laboratory analyses determined the following:

- The materials at the site consist of low permeability natural sediments, fill, and waste materials. The low permeability limits surface water infiltration and limits mobility of compounds in the subsurface and their potential to impact groundwater in the underlying natural sediments.
- Several compounds were detected in soil and groundwater at concentrations above their respective non-residential standards. However, the number of compounds detected in groundwater at concentrations above the standards is substantially fewer than in the soil.
- The concentrations of many substances, particularly SVOCs, pesticides, and PCBs, are below the groundwater MSCs despite concentrations in saturated soils that exceed the soil to groundwater pathway standard. This indicates that the soil and fill are naturally attenuating these compounds.

The analytical results for LNAPL indicated the presence of one VOC, dichloromethane, at a concentration lower than the non-residential used aquifer soil to groundwater pathway MSC of 500 ug/kg. No SVOCs were detected in the sample above the laboratory detection limits. Raytheon concluded that the gas chromatograph fingerprint indicated the LNAPL peak pattern matched the pattern for 10W40 motor oil or lube oil.

3.3.1 WATER

3.3.1.1 Groundwater

Groundwater samples were collected from pre-existing wells MW-40 and MW-118 and newly installed wells MW-137 through MW-146 on February 23 through 25, 2000. A second round of groundwater samples were collected on April 27, 2000 from wells MW-40, MW-113 through MW-118, MW-121, and MW-137 through MW-146.

At the time of installation, the new wells were numbered sequentially from MW-1 through MW-11. Since then, the wells have been incorporated into the Sunoco well network and were re-numbered MW-137 through MW-146. In this report, the wells are referred to by their new designation. The laboratory data reports in the appendices will bear the original well designations. URS has provided notations on each laboratory data sheet corresponding to the revised well designation to facilitate cross-referencing. The monitoring wells were properly abandoned in May 2002 during construction of the co-generation facility

The groundwater sampling events required several days to complete due primarily to the slow recharge of the wells. The first round of groundwater samples was analyzed for the parameters listed in Table 1. The second round of groundwater samples was analyzed for VOCs, SVOCs, and dissolved metals.

The groundwater sample analyses detected four VOCs and two SVOCs at concentrations above their respective non-residential used aquifer MSCs as follows:

- Benzene was detected above its MSC of 5 ug/l in the same two wells of the 12 wells from which groundwater samples were collected in both rounds of groundwater sampling;
- Dichloromethane (methylene chloride) was detected above the MSC of 5 ug/l in only one of the 12 groundwater samples in the February 25, 2000 round and in three of the 12 samples in the April 27, 2000 round of sampling;
- Methyl tertiary butyl ether (MTBE) was detected above the MSC of 20 ug/l in the same two of the 12 groundwater samples collected in the February 25, 2000 round and the April 27, 2000 round of sampling;
- Trichloroethylene (TCE) was not detected in any of the groundwater samples from the February 25, 2000 round, but was detected in one of the 12 groundwater samples in the April 27, 2000 round of sampling;
- 4-Methylphenol (cresol) was detected above the non-residential use aquifer MSC of 100 ug/l in the same sample from both groundwater sampling rounds; and
- Bis(2-ethylhexyl)phthalate was detected at concentrations above the MSC of 6 ug/l in three groundwater samples in the February 25, 2000 round and one sample in the April 27, 2000 round. However, the compound was also detected in the equipment blank from the February 25, 2000 round (but not in the blank from the April 27, 2000 round) at a concentration above those detected in the samples. Therefore, the detection of this compound in the groundwater samples is suspect (and is likely a laboratory introduced contaminant) but was evaluated by fate and transport modeling.
- Three metals, arsenic, cadmium, and lead, were detected at concentrations above the non-residential used aquifer MSCs in the February 25, 2000 groundwater samples. The same three metals and selenium were detected at concentrations above the non-residential used aquifer MSCs in the April 27, 2000 groundwater samples.

The location and concentration of groundwater samples that exceeded the groundwater MSCs are depicted on Figures 10a and 10b for the February 25, 2000 and April 27, 2000 rounds, respectively.

Because the locations in which the compounds discussed above were detected are distributed throughout the site, a specific, localized source area(s) does not appear to be present. Instead, the data implies that the source materials and associated compounds are distributed heterogeneously throughout much of the site.

3.3.1.2 Soil Pore Water

Though the soil pore water is not considered groundwater, the analytical results were compared to non-residential used aquifer MSCs for discussion purposes. The following compounds were detected at concentrations above their non-residential used aquifer MSCs in the pore water samples from April 27, 2000:

- Benzene was detected in one of the six samples above the MSC of 5 ug/l; and

- The SVOC bis(2-ethylhexyl)phthalate was detected in four of the six samples at concentrations above the MSC of 6 ug/l.

Three metals, cadmium, lead, and selenium, were detected at concentrations above the non-residential used aquifer MSCs in the April 27, 2000 pore water samples.

Because the locations in which the compounds discussed above were detected are distributed throughout the site, a specific, localized source area(s) does not appear to be present. Instead, the data implies that the source materials and associated compounds are distributed heterogeneously throughout much of the site.

3.3.2 SOIL

Soil samples were obtained from Geoprobe® and auger soil borings. The samples were field screened for VOCs with a photoionization detector (PID). In the Geoprobe® borings, URS collected composite soil samples, one per every four-foot interval, down to 16 feet bgs. Discrete soil samples were collected from the interval of highest PID reading for VOCs or from intervals displaying visible indications of staining or impact from operations.

In the hollow-stem auger borings, four discrete samples were collected over a two-foot interval from the following zones:

- 0 to 2 feet bgs;
- 2 to 15 feet bgs and immediately above the water table if it was encountered in the first 15 feet;
- The zone of highest PID reading or greatest visible impact; and
- The bottom of the boring (native soils).

Soil samples were analyzed for the parameters listed in Table 1.

3.3.2.1 Surface Soil

Two pesticides, alpha-BHC and beta-BHC, exceeded their corresponding soil to groundwater non-residential used aquifer MSCs of 190 and 820 ug/kg. Alpha-BHC was detected at two of the 18 sample locations (B-PH2 and MW-145), and beta-BHC was detected at one of the 18 sample locations (MW-145). The infrequent and isolated occurrences of the pesticides indicate they are not commonly associated with the fill or waste that was placed at the site.

Note that for many of the compounds, the detection limits exceeded the MSC. These compounds are included on Table 2. However, these compounds were not detected in the groundwater samples. Furthermore, for many of the compounds, the corresponding groundwater concentration was below the MSCs or the compound was not detected. This indicates that the compounds are either not present or do not present a threat to groundwater and the environment.

3.3.2.2 Unsaturated Subsurface Soil

Two VOCs, benzene and dichloromethane, and one SVOC, naphthalene, were detected in subsurface soils at concentrations above their respective soil to groundwater non-residential used aquifer MSCs. The pesticide 4,4'-DDD was detected above the soil to groundwater non-residential used aquifer MSC at a depth of 12 to 14 feet bgs at one location (boring MW-138). Arsenic exceeded the soil to groundwater non-residential used aquifer MSC at a depth of 16 to 18 feet bgs at one location (boring MW-140).

The location, depth, and concentration of unsaturated subsurface samples that exceeded the soil to groundwater non-residential used aquifer MSCs are depicted on Figure 11. The compounds detected in the soil samples appear randomly across the site. A pattern that might indicate a specific source area is not apparent.

Note that for many of the compounds, the detection limits exceeded the MSC. These compounds are included on Table 2. However, these compounds were not detected in the groundwater samples. Furthermore, for many of the compounds, the corresponding groundwater concentration was below the MSCs. The exceptions were benzene and dichloromethane, which indicate that the compounds are either not present or do not present a significant threat to groundwater and the environment.

3.3.2.3 Saturated Subsurface Soil

The VOC dichloromethane was detected in two of 15 saturated soil samples at concentrations above the non-residential soil to groundwater non-residential used aquifer MSC of 500 ug/kg. Five metals, arsenic, cadmium, lead, mercury, and selenium, were detected above the non-residential used aquifer MSC. These data are not graphically presented as these samples were from the indigenous sediments and likely represent background soil conditions. Compounds detected in the saturated sediments are addressed through the groundwater exposure pathway.

3.3.3 LNAPL RESULTS

URS collected LNAPL samples from open borehole B-PH10 and wells MW-113, MW-115, MW-116, MW-119, MW-121, and MW-121A for specific gravity and PCB analyses. Additionally, a sample of LNAPL was collected from MW-116 and analyzed for VOCs, SVOCs, and petroleum fingerprint. LNAPL samples were also collected from the west shore sump and a seep at the high tide water level beneath the west shore sump for analysis of petroleum fingerprint. A soil sample was collected from the shoreline beneath the sampled seep.

The results of the LNAPL analyses indicated the following:

- No PCBs were detected in the seven LNAPL samples;
- No SVOCs were detected above the laboratory detection limits;
- The specific gravity ranged between 0.92 and 0.94 g/cc indicating it to be a heavy, weathered petroleum product with a large unresolved component fraction. Raytheon concluded that the gas chromatograph fingerprints (peak patterns) of the four LNAPL

samples submitted for fingerprint analysis are similar to the pattern for 10W40 motor oil or lube oil;

- All analyte specific compounds are below the non-residential used aquifer soil to groundwater MSCs which were used to provide an indication of the potential for the LNAPL to leach dissolved constituents into groundwater;
- One LNAPL sample submitted for VOC and SVOC analysis, contained dichloromethane at a concentration of 240 ug/kg, which is below its non-residential used aquifer soil to groundwater pathway MSC of 500 mg/kg. This compound was also detected in the blank at a concentration of 10 ug/l.

This section presents the results of fate and transport modeling and assesses the potential impact from site groundwater to surface water quality. The results of the modeling were used to assess the potential exposure pathways and risk to human and ecological receptors, results of which are discussed in Section 5.0.

Groundwater elevation measurements at the site indicate that groundwater flow is toward the Delaware River. Based on these measurements, and information concerning the geology and hydrogeology at the site, groundwater is expected to discharge to the Delaware River where it will mix with the surface water in the river.

Tables 4 and 5 of this report summarize the groundwater sample analytical results. The analytical results indicate that the concentrations of benzene, dichloromethane, MTBE, trichloroethylene, bis(2-ethylhexyl)phthalate, 4-methylphenol (cresol), arsenic, cadmium, lead, and selenium detected in groundwater exceed the groundwater non-residential used aquifer MSCs.

4.1 FATE AND TRANSPORT ANALYSIS

URS evaluated the potential groundwater discharge of compounds detected above the MSCs to the Delaware River using Quick Domenico, a spreadsheet model modified by PADEP to estimate the distance that a plume will travel from a source (PADEP Land Recycling Program Technical Guidance Manual). Quick Domenico uses the Domenico equation (P.A. Domenico, 1987) to calculate the concentrations of a regulated substance in a vertical cross section of a retarded plume at a known distance to a stream or other discharge boundary. The Quick Domenico model is primarily intended for use with dissolved organic compounds that may react with organic carbon in the soil and/or may be subject to biodegradation or reaction that can be described by first order decay.

The historic placement of fill and waste at the site has resulted in areas of groundwater impact. These constituents do not appear to be widespread nor do they display typical concentration gradients in groundwater across the site that would indicate they have resulted from the spent filter clay. Instead, the sporadic detections of these constituents in groundwater across the site suggest heterogeneous material. The Quick Domenico model provides a tool to quantitatively assess potential migration of the constituents of concern in the groundwater. In applying this model, we have made several assumptions about the size and concentrations of the sources. These assumptions are identified below.

The model was run twice for a comparison of the sensitivity of the model to selected input parameters.

4.1.1 MODEL ANALYSIS – FIRST RUN

The key model input parameters and their sources consisted of the following:

- Source Concentration: The highest groundwater concentration of:
 - benzene - MW-118 (50 µg/l)
 - dichloromethane - MW-137 (20 µg/l)
 - trichloroethylene - MW-145 (48 µg/l)
 - bis(2-ethylhexyl)phthalate - MW-145 (40 µg/l)
 - 4-methylphenol - MW-143 (220 µg/l)
- Distance to Location of Concern: Feet from monitoring well MW-118, MW-137, MW-143 and MW-145 to the distance where the concentration in groundwater is below the MSC
- Longitudinal Dispersivity: 1/10 of the distance to the location of concern
- Transverse Dispersivity: 1/10 of the longitudinal dispersivity
- Vertical Dispersivity: 0.0001 feet using the default coefficients recommended by PADEP for conceptual applications
- Lambda (days⁻¹): 0.000959/day for benzene, 0.0123/day for dichloromethane, 0.00005/day for trichloroethylene, 0.0017/day for bis(2-ethylhexyl)phthalate, 0.0141/day for 4-methylphenol first-order decay constants – 25 Pa. Code Chapter 250, Appendix A, Table 5A (converted to daily degradation coefficients as required by the model)
- Source Width: unknown – assumed a width of 100 feet
- Source Thickness: 42 feet, the average depth to native materials in that area of the site
- Hydraulic Conductivity: 2.61 feet/day for MW-137, 0.563 feet/day for MW-118 and MW-145, and 0.02291 feet/day for MW-143 estimated by slug testing at the site
- Hydraulic Gradient: 0.0225, the average hydraulic gradient measured at the site (March 15, 2000) for MW-118, MW-137, and MW-143, and 0.0048 MW-118 and MW-145
- Porosity: 30%, the default value recommended by PADEP
- Soil Bulk Density: 1.7 g/cm³, the average for soil, recommended by PADEP
- Organic Carbon Coefficient (KOC): 58 for benzene, 16 for dichloromethane, 93 for trichloroethylene, 87000 for bis(2-ethylhexyl)phthalate, and 25 for 4-methylphenol, from 25 Pa. Code Chapter 250, Appendix A, Table 5A
- Fraction Organic Carbon (foc): 0.005 default recommended by PADEP
- Time (days): 10,950 days (30 years)

The remainder of the parameters, presented in Appendix D, were calculated by the Quick Domenico model and include retardation and velocity of groundwater flow.

trichloroethylene, bis(2-ethylhexyl)phthalate, and 4-methylphenol are presented in Appendix D. The Quick Domenico model estimates:

- The benzene concentration will be less than the applicable MSC 50 feet from MW-118
- The dichloromethane concentration was estimated to be below the MSC 19 feet from MW-137
- The trichloroethylene concentration was estimated to be below the MSC 60 feet from MW-145
- The bis(2-ethylhexyl)phthalate concentration was estimated to be below the MSC 1 foot from MW-145
- The 4-methylphenol concentration will be less than the applicable MSC 1 foot from MW-143

The model projects attenuation of constituents over very short distances from sources. The historic land use makes it difficult to assess the source locations and sizes; however, the rapid attenuation of these constituents is expected to minimize the migration of benzene, dichloromethane, trichloroethylene, bis(2-ethylhexyl)phthalate, and 4-methylphenol to the Delaware River. The analysis demonstrates that the controlling factor limiting the transport of contaminants in groundwater at the site is the low hydraulic conductivity of the fill and native materials at the site.

4.1.2 MODEL ANALYSIS – SECOND RUN

URS varied some of the input parameters used in the Quick Domenico model for fate and transport analysis at the site for evaluation of the sensitivity of the model to those parameters. The key model input parameters that were changed for the second calculation and their sources consisted of the following:

Parameters changed for the second calculation:

- Hydraulic Gradient: 0.0225 for MW-118, 0.0225 for MW-137, 0.013 for MW-141, 0.41 for MW-143, and 0.0022 for MW-145; well-specific hydraulic gradient calculated from the March 15, 2000 gauging event.
- Porosity: 20%, the default value recommended by PADEP, first version of Technical Guidance Manual, 1995
- Soil Bulk Density: 1.8 g/cm³, the average for soil, recommended by PADEP, first version of Technical Guidance Manual, 1995
- Fraction Organic Carbon (foc): 0.0025 default recommended by PADEP, first version of Technical Guidance Manual, 1995

The results obtained by using the Quick Domenico model for benzene, dichloromethane, trichloroethylene, bis(2-ethylhexyl)phthalate, and 4-methylphenol are attached in Appendix E.

In each case changing the input parameters did not appreciably change the distance traveled until the applicable MSC is met (i.e., did not intercept a potentially sensitive receptor such as the Delaware River). The Quick Domenico model estimates:

- The benzene concentration will be less than the applicable MSC 80 feet from MW-118 and less than one foot from MW-141.
- The dichloromethane concentration was estimated to be below the MSC 27 feet from MW-137
- The trichloroethylene concentration was estimated to be below the MSC 35 feet from MW-145
- The bis(2-ethylhexyl)phthalate concentration was estimated to be below the MSC 1 foot from MW-145
- The 4-methylphenol concentration will be less than the applicable MSC 2 feet from MW-143

As before, the model projects attenuation of constituents over short distances from sources. The analysis demonstrates that the controlling factor limiting the transport of contaminants in groundwater at the site is the low hydraulic conductivity of the fill and native materials.

4.2 SURFACE WATER IMPACT ASSESSMENT

Section IV (A)(3) of the Act 2 Technical Guidance Manual provides guidelines for assessing the impact to surface waters from the diffuse flow of impacted groundwater into surface waters. Specifically, the guidelines provide protocols for determining whether the diffuse flow of groundwater into surface waters will cause the surface waters to violate water quality standards contained in 25 Pa. Code Chapter 16.

URS performed an evaluation consistent with the guidelines set forth in the Act 2 Technical Guidance Manual to determine the potential impact on surface waters from groundwater beneath the site discharging into the Delaware River. The regulated substances that were evaluated were those detected in groundwater at levels exceeding one or more of the surface water quality standards. In the absence of certain site-specific information, values for particular parameters have been estimated using information from available literature (*as referenced*). An effort was made to keep all assumptions conservative, thereby approximating reasonable worst case conditions.

To determine the surface water concentration of a particular regulated substance resulting from the diffuse flow of groundwater containing that substance into surface waters, the Act 2 Technical Guidance Manual provides the following equation:

Equation 1:

$$C_{sw} = \frac{Q_{gw} \times C_{gw}}{Q_{sw}}$$

Where: C_{sw} = Concentration in surface water ($\mu\text{g/l}$); *calculated*
 C_{gw} = Average concentration in groundwater ($\mu\text{g/l}$); *February 23 – 25, 2000 groundwater sampling event*
 Q_{sw} = Harmonic Mean Flow or Q_{7-10} (cubic feet/sec [cfs])
 Q_{7-10} = 7 day/10 year low flow;
Data from the United States Geological Survey, West Trenton, New Jersey station (closest gauging station to the site)
 Q_{gw} = Groundwater discharge rate (cubic feet/sec); *Equation 2*

Q_{gw} is estimated as follows:

Equation 2:

$$Q_{gw} = KIA$$

Where: K = Hydraulic conductivity (4.59 ft/day, *the average hydraulic conductivity at the site based on the slug testing results*)
 I = Hydraulic gradient (0.0225, *the average hydraulic gradient at the site based on the March 15, 2000 groundwater contour map*)
 A = Cross sectional area of discharge to river (41,200 ft^2 , *the cross sectional area of discharge to river assuming a 20 foot thick interface between groundwater and the river*)

Q_{sw} consists of either the Harmonic Mean Flow (“HMF”) or the Q_{7-10} values for the Delaware River. The procedures set forth in the Act 2 Technical Guidance Manual require use of the HMF when evaluating carcinogens and the Q_{7-10} when evaluating non-carcinogens. The HMF and Q_{7-10} for the Delaware River at the site were calculated on the basis of information provided by the United States Geological Survey in Harrisburg, Pennsylvania for the West Trenton, New Jersey station. The West Trenton station is the closest gauging station to the site. The Q_{7-10} value was determined to be 1,700 cfs.

The HMF was determined to be approximately 6,170 cfs. The flow values from the West Trenton station are likely to be lower than the Delaware River flow at the site as several large tributaries (e.g., Neshaminy Creek, Schuylkill River) enter the Delaware River between the West Trenton gauging station and the site. The flow values from the West Trenton station therefore represent a highly conservative estimate for the surface water concentrations resulting from the diffuse flow of groundwater to the Delaware River.

The Chapter 16 standards for benzene, dichloromethane, trichloroethylene, bis(2-ethylhexyl)phthalate, and 4-methylphenol are 1 $\mu\text{g/l}$, 5 $\mu\text{g/l}$, 3 $\mu\text{g/l}$, 2 $\mu\text{g/l}$, and 159 $\mu\text{g/l}$, respectively. Based on the calculations using site-specific hydraulic properties, a benzene

groundwater concentration of 124,681 µg/l is required before the surface water standard is exceeded. Similarly, a groundwater concentration for dichloromethane, trichloroethylene, bis(2-ethylhexyl)phthalate, and 4-methylphenol of 623,000 µg/l, 374,000 µg/l, 68,700 µg/l, and 5,426,000 µg/l, respectively, is required before the surface water quality standard is exceeded. The concentrations detected in the groundwater samples are substantially less than these calculated values. Based on these analyses, discharge of groundwater containing benzene, dichloromethane, trichloroethylene, bis(2-ethylhexyl)phthalate and 4-methylphenol to the Delaware River will not cause surface water to exceed the surface water quality standards contained in 25 PA Code Chapter 16.

To further evaluate the potential for impact to the Delaware River, URS used the surface water mixing equations to calculate the average concentration of dissolved metals that would need to be present in groundwater exiting the site to raise the concentration in surface water to the Chapter 16 standards. The Chapter 16 standards for arsenic, cadmium, lead, and selenium are 50 µg/l, 1 µg/l, 2.5 µg/l, and 4.6 µg/l, respectively. Based on the calculations using site-specific hydraulic properties, a groundwater concentration for arsenic, cadmium, lead, and selenium of 1,717,000 µg/l, 34,300 µg/l, 85,800 µg/l, and 158,000 µg/l, respectively, is required before the surface water quality standard is exceeded. The concentrations detected in the groundwater samples are substantially less than these calculated values. Based on these analyses, discharge of groundwater containing arsenic, cadmium, lead, and selenium to the Delaware River will not cause surface water to exceed the surface water quality standards contained in 25 PA Code Chapter 16.

In this section the potential exposure pathways are evaluated based on the site-specific chemical and physical characteristics of the site. For each exposure pathway, the current and future use scenarios are assessed.

5.1 IDENTIFICATION OF COMPOUNDS OF POTENTIAL CONCERN

Compounds of potential concern (COPCs) are identified based on their potential to effect human health and the environment. For this study, groundwater results were screened against the Act 2 non-residential used aquifer MSCs. Soil sampling results were screened against the Act 2 Statewide Standards for Non-residential Direct Contact and the Soil to Groundwater pathway for Non-residential Used Aquifers.

The screening results for the groundwater identified dichloromethane, benzene, trichloroethylene, bis(2-ethylhexyl)phthalate, 2-methylphenol, arsenic, cadmium, lead, and selenium as COPCs for groundwater.

For the surface and subsurface soils, the detection limits for several of the SVOCs were above either the non-residential used aquifer soil to groundwater pathway MSCs or the surface and subsurface direct contact MSCs. To assess the potential for these compounds to be present above the MSCs, these constituents will be included in the exposure characterization (Section 5.2).

The screening results for soil indicated the following COPCs were detected:

Chemical	Exceeded Direct Contact (0-2 ft)	Exceeded Soil to Groundwater Pathway
Surface Soil		
alpha-BHC	Yes	Yes
beta-BHC	No	Yes

Alpha-BHC exceeded the non-residential direct contact MSC of 13,000 ug/kg at one location (MW-145) at a concentration of 49,000 ug/kg.

Chemical	Exceeded Direct Contact (0-2 ft)	Exceeded Direct Contact (2-15 ft)	Exceeded Soil to Groundwater Pathway
Subsurface Soil – Unsaturated			
Dichloromethane	No	No	Yes
Benzene	Yes	Yes	Yes
Naphthalene	No	No	Yes
Arsenic	Yes	No	Yes

Note that benzene was detected above the direct contact surface and subsurface soil non-residential MSCs at one location, B-PH8 from 24-26 feet bgs. Arsenic was detected in one

sample above the direct contact surface non-residential MSC at one location, MW-140 from 16-18 feet bgs. However, it should be noted that both of these samples were collected from a depth of greater than 15 feet bgs (the Act 2 limit for potential direct contact exposure).

Chemical Exceeded Soil to
 Groundwater Pathway

Subsurface Soil – Saturated

Dichloromethane	Yes
Arsenic	Yes
Cadmium	Yes
Lead	Yes
Mercury	Yes
Selenium	Yes

Note that dichloromethane was detected in only two of 15 soil samples. Dichloromethane exceeded the non-residential direct contact (2-15 ft) MSC in one sample, B-PH3 (14-16). Arsenic and lead were detected in five and three soil samples, respectively. Cadmium, mercury, and selenium were detected in one soil sample each.

5.2 EXPOSURE CHARACTERIZATION

The objective of the exposure characterization is to determine the media and pathways through which receptors are exposed to site compounds. Potential exposure pathways are dependent on the ecosystems and land use at the site, the receptors present, the nature and extent of contamination, and the fate and transport of COPCs.

The areas of concern at this site are the subject property and the Delaware River. Humans, as well as terrestrial and aquatic ecological receptors, can potentially be exposed to contaminants at this site. The receptors considered for evaluation of potential exposure pathways include current and future workers and ecological receptors.

Each of these potential exposure routes has been evaluated in this risk assessment. The results of the evaluations of each exposure route to human health are presented in Section 5.2.1 through 5.2.9. The ecological exposure characterization is presented in Section 5.3.

5.2.1 GROUNDWATER INGESTION AND DERMAL CONTACT

To assess potential groundwater use in the vicinity of the site URS performed a well search and contacted the local water company to determine its service area. The well search performed by NUS in 1987 did not identify any groundwater users within three miles of the site. PADEP Act 2 requires a well search radius of 0.5 mile to determine groundwater use. URS contacted the Pennsylvania Water Well Drillers Licensing and Records Section to confirm the results of the well search. A database search of the available public well records maintained by the Department of Conservation and Natural Resources was also performed. The search revealed no private or public water wells within 0.5 mile of Phillips Island.

The Chester Water Authority supplies drinking water for the site, the Borough of Marcus Hook, and the neighboring towns of Lower Chichester Township and Trainer Borough.

The co-generation plant site development does not include a water supply well nor are there plans for installing any water supply wells in the future.

On the basis of this well survey, there are no wells in use within the downgradient area of interest. Thus, there is no exposure via either ingestion of, or dermal contact with, site groundwater. Groundwater ingestion and groundwater dermal contact are not complete exposure routes of concern at the site and are eliminated from further consideration.

5.2.2 GROUNDWATER VAPOR INHALATION

Groundwater occurs under semi-confined conditions from a depth of 15 to 42 feet bgs. The soil thickness will mitigate the effects of constituent volatilization from groundwater and potential effects on receptors. The occupied co-generation plant buildings include a passive vapor control system (see Section 6.0 for a detailed discussion) thereby eliminating the potential for worker exposure inside buildings. Therefore, the groundwater vapor inhalation exposure pathway is not a significant pathway and is eliminated from further consideration.

5.2.3 SOIL DIRECT CONTACT

The analytical results indicated one COPC above the direct contact non-residential MSC in one surface soil sample. The unsaturated subsurface soil sample results indicated two COPCs above the direct contact non-residential MSCs; both COPCs were detected above the MSCs in only one soil sample. The detection limits for the SVOCs 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, aniline, benzo(a)pyrene, bis(2-chloroethyl) ether, and n-nitroso-di-propylamine were above the non-residential direct contact MSCs. Therefore, these compounds are considered COPCs for the soil direct contact exposure pathway.

The soil exposure pathway for workers on Phillips Island is through direct contact. In areas of activity, the site surface is covered with gravel or paved with concrete. Others areas of the site have been covered with asphalt or gravel to collect stormwater (see Section 8.0). Therefore, the soil direct contact exposure pathway has been eliminated and is removed from further consideration.

5.2.4 INHALATION OF VAPORS FROM SOIL

PADEP direct contact MSCs for VOCs in surface (0-2 feet) and subsurface soil (2 to 15 feet) is based on an inhalation model assuming contact 8 hours per day, 250 days per year for 25 years. None of the soil samples collected from a depth of between 0 and 15 feet contained compounds at concentrations above the direct contact MSCs. Therefore, worker exposure under the current use scenario is not considered a significant exposure pathway and is not of concern to site personnel.

Construction of the co-generation plant included installing passive vapor control systems beneath all occupied buildings. This effectively eliminates the potential exposure pathway via soil vapors and is not considered a significant exposure pathway.

5.2.5 SURFACE WATER DIRECT CONTACT

URS modeled the transfer of COPCs via groundwater migration into the surface waters of the Delaware River. Model results indicate that surface water quality standards will not be exceeded. Therefore surface water direct contact with dissolved compounds is not an exposure pathway of concern.

5.2.6 LNAPL DIRECT CONTACT

The results of the LNAPL sample analysis indicated that one compound, dichloromethane, was detected above the detection limits. The concentration of dichloromethane (240 ug/kg) is below the non-residential used aquifer soil to groundwater pathway MSC of 500 ug/kg, and is below the non-residential surface and subsurface soil direct contact MSCs. The detection limits for the SVOCs were elevated due to matrix interference (concentrations of other petroleum compounds). However, the detection limits, generally between 0.4 and 10 mg/kg, are below the non-residential surface and subsurface soil direct contact MSCs. Therefore, SVOCs are not considered COPCs.

Though the chemical composition of the LNAPL does not pose a threat to human health or the environment, the physical discharge of the LNAPL is considered a complete pathway.

5.2.7 INHALATION OF VAPORS FROM LNAPL

PADEP direct contact MSCs for VOCs in surface (0-2 feet) and subsurface soil (2 to 15 feet) is based on an inhalation model assuming contact 8 hours per day, 250 days per year for 25 years. The LNAPL sample did not contain compounds at concentrations above the direct contact MSCs. Therefore, worker exposure under the current use scenario is not considered a significant exposure pathway and is not of concern to site personnel.

Construction of the co-generation plant included installing passive vapor control systems beneath occupied buildings. This effectively eliminates the potential exposure pathway via soil vapors and is not considered a significant exposure pathway.

5.2.8 EXPOSURE DURING CONSTRUCTION

Act 2 does not directly address short-term worker exposure, specifically during construction involving earthmoving and excavation. Therefore, this exposure pathway was not considered for inclusion in the Cleanup Plan submitted as Section 8.0 of the July 2000 Combined Report. However, this potential exposure pathway was assessed to identify potential risks and address those risks as part of the overall construction operations pursuant to the Occupational Safety and Health Administration requirements (49CFR1910).

Exposure to soil by way of direct contact (ingestion and inhalation) during construction activities (i.e., a construction worker scenario) was assumed to occur at the site for a small group of workers excavating in potentially impacted soils. Because Pennsylvania Act 2 did not provide for evaluation of a construction worker during "typical" construction activities, guidance from other sources^(15,16,17,18) was used to calculate risk-based target concentrations. Target concentrations were calculated for combined exposure via inhalation of vapors and dust from the area, dermal contact with the soil, and incidental ingestion of soil.

For generation of target risk-based exposure values for a construction worker, which correspond to the lower of one-in-one hundred thousand cancer risk or a hazard index of 1, it was assumed that a 70 kg construction worker was exposed for 5 days/week for 12 weeks over a period of 1 year⁽¹⁶⁾. The construction worker had 3,300 cm² of exposed skin (i.e., head, forearms, and hands) that allowed for dermal contact with soil⁽¹⁶⁾. The amount of soil adherence to exposed skin was 0.12 mg/cm²⁽¹⁶⁾. The assumed soil ingestion rate was 480 mg/day over the 60-day exposure period^(16, 17, 18). Since incidentally ingested soil occurs primarily as a result of hand-to-mouth contact, it is likely that the risk-based target concentrations overstate risk to a construction worker.

The results of the calculated risk-based target concentrations are presented in Appendix F. Comparison of these calculated values to the concentrations detected in surface soil, subsurface soil, and LNAPL indicate that benzene and arsenic were detected above the calculated exposure concentrations. The benzene cancer and non-cancer concentrations are 1,699 mg/kg and 114 mg/kg, respectively. Benzene was detected above these concentrations at one location, B-PH8 at a depth of 24 to 26 feet; benzene concentrations otherwise ranged between 0.5 mg/kg and 38 mg/kg.

The arsenic cancer ingestion concentration is 414 mg/kg. Arsenic was detected in two samples (B-H11 [22-24'] and MW-140[16-18']) at concentrations of 430 and 1,100 mg/kg. Arsenic in other soil samples ranged between 1 and 190 mg/kg.

The risk-based target concentrations were calculated for the SVOCs with detection limits above the non-residential direct contact MSCs. With the exception of benzo(a)pyrene and bis(2-chloroethyl)ether, the risk-based target calculations indicate the acceptable exposure concentrations for these SVOC compounds are above the detection limits for soil samples from the remedial investigation.

The results indicate that the potential exists for benzene and arsenic to be present at high concentrations. Similarly, as the detection limits for benzo(a)pyrene and bis(2-chloroethyl)ether are above the risk-based target concentrations, measures will be implemented during earthwork to minimize potential worker exposure to ingestion of site soils. Potential exposure to site constituents during the excavation activities performed during the site development were addressed in a Sampling and Monitoring program during excavation activities.

5.2.9 INDUSTRIAL WORKER EXPOSURE

URS evaluated the cumulative cancer and noncancer risk of exposure using conservative default assumptions for a person standing outside coming in direct contact with exposed soil by way of

incidental ingestion, dermal contact and inhalation of vapors and dust. This evaluation is included in the attached narrative titled "Evaluation of Cumulative Risk for the Soil Medium Assuming an Industrial Worker Exposure Scenario" with accompanying spreadsheet calculations (Appendix G). The results show that using conservative default assumptions the calculated cumulative cancer risk is within the one-in-ten thousand (10^{-4}) to one-in-one million (10^{-6}) USEPA risk range and the cumulative noncancer risk is below the USEPA hazard index of 1.

5.3 ECOLOGICAL EXPOSURE CHARACTERIZATION

An evaluation of ecological receptors was performed in accordance with the rules and regulations provided in section 250.311, of the Pennsylvania Bulletin Volume 27, Number 33, August 16, 1997 as a screening tool for the many regulated substances that meet the statewide health standards. The purpose of this ecological screening is to identify whether features at the site pose potential concern to ecological communities and therefore would require further investigation. Both historical and baseline information used in this evaluation was gathered during various phases of investigation and incorporated into the screening process. Since the ecological screening process is a part of the site characterization, detailed descriptions of site features addressed in this evaluation can be found in other sections of this document.

Two primary ecological components, a terrestrial or upland region and a shoreline area along the Delaware River characterize the site. These two components are examined based on the site characterization as it relates to historic, current, and future uses. A qualitative "weight of evidence" approach was used throughout the evaluation to characterize ecological exposure for the terrestrial uplands and shoreline areas.

Preliminary characterization of the site includes the assessment of onsite features that eliminate specific exposure pathways. Based on site use and layout, several upland area features eliminate specific ecological exposure pathways including:

- The site is zoned industrial, surrounded by the refinery, and primarily covered with gravel.
- The disturbed, isolated nature of the limited upland shrub/scrub habitat (< 2 acres) and its proximity to industrial activities likely limits potential wildlife use.

With this information in mind, field inspections of the terrestrial uplands and shoreline areas during both high and low tides were performed. Each habitat was screened and is discussed separately below.

Based on the evaluation of the Phillips Island site the following conclusions can be reached regarding the ecological screening.

5.3.1 TERRESTRIAL

- Industrial site features and proximity to industrial activities preclude terrestrial flora and their associated habitats;
- Lack of terrestrial habitat precludes occupation and use by wildlife; and

- Given the lack of complete exposure pathways, no further ecological action is anticipated for the terrestrial area of the Phillips Island site.

5.3.2 SHORELINE AND ADJACENT RIVER AREA

- No endangered, threatened, and special concern shorebirds or mammals were identified for the Phillips Island site.
- Two fish species, the shortnose sturgeon and Atlantic sturgeon, classified as threatened and endangered could pass near Phillips Island shoreline although no current or historic observations have been made at the site.
- Shoreline areas of the Phillips Island site are important features in controlling bank erosion and as such do not support features that provide valued habitat to fish and wildlife;
- The industrial environment and available shoreline habitat is generally not consistent with habitat viewed as essential or important for threatened, endangered, or common species of fish and wildlife;
- Potential for individual exposure to CPECs in shoreline areas is highly variable and overall slight; potential for population or community level exposure is virtually nonexistent; and
- Given the relatively small size of the shoreline areas, the paucity of valuable fish and wildlife habitat, and the lack of complete and important exposure pathways, no further ecological action is anticipated for the shoreline areas of the Phillips Island site.

5.4 SUMMARY OF POTENTIAL EXPOSURE PATHWAY ASSESSMENT

Based on the results of the risk assessment and ecological survey, the complete potential exposure pathways, whether significant or insignificant, identified prior to implementation of the approved remedial actions, were:

- Groundwater vapor inhalation;
- Soil direct contact;
- Soil vapor inhalation;
- LNAPL vapor inhalation; and
- LNAPL direct contact.

Since the implementation/construction of the engineering controls for remediation of the site, all of the potential exposure pathways listed above have been eliminated.

Section 8.0 of the July 2000 Combined Report presented a detailed description of the institutional and engineering controls proposed to control constituent migration and eliminate potential exposure pathways that were identified at Phillips Island as a result of the previous studies/investigations, and achieve acceptable site-specific standards under Act 2. For soil, surface water, and vapors, the potential exposure pathways have been eliminated through engineering controls including installation of vapor barriers, surface capping, impacted soil removal, and stormwater management. Control of LNAPL migration and elimination for potential direct contact exposure to LNAPL has been accomplished through installation of a subsurface barrier wall and active LNAPL recovery to eliminate seeps. More detailed descriptions of the remedial actions performed at the site are provided below.

6.1 REMEDIAL ACTION IMPLEMENTATION

Based on the use of the site and the site conceptual model, the cleanup plan for the site included these key engineering control elements:

- Passive vapor control beneath occupied co-generation plant buildings;
- Enhanced LNAPL recovery and seepage elimination with a barrier;
- Removal of impacted soil from around the seep near the top of the west bank of the berm; and
- Stormwater control and infiltration minimization.

In addition, extensive clean cover and/or capping materials such as gravel, asphalt, and concrete have been placed across much of the site surface, which aids in eliminating potential direct contact scenarios.

Implementation of these engineering control remedies has eliminated exposure pathways (direct contact and inhalation) and mitigated potential migration of compounds detected at the site. The remedial actions are described, plans and specifications presented, and operation and maintenance activities discussed, in the following sections.

6.1.1 PASSIVE VAPOR CONTROL BENEATH BUILDINGS

6.1.1.1 Objective

The results of the remedial investigation indicated there was no potential for worker exposure to vapors from the subsurface soil or groundwater. Therefore, active vapor control was not necessary to meet the applicable site-specific standard. However, to provide further assurances against any potential for vapor intrusion, a passive vapor collection system was installed beneath the only occupied co-generation project building.

6.1.1.2 Remedial Action Description

The potential exposure pathway for vapor infiltration into the only occupied co-generation project building has been eliminated by installation of a passive system beneath the building. The passive vapor system was installed by Stone & Webster, Inc. of Cherry Hill, New Jersey as part of the new building construction.

The only occupied building was constructed with concrete floors set above a gravel sub-base. A passive vapor control system was installed prior to building construction and consisted of a series of slotted PVC pipe, laid in the gravel sub-base, and connected to a common header that conveys vapor, if any, to a vertical stack pipe. Any gas that rises vertically in the vicinity of the building is intercepted and collected by the horizontal layer of gravel and conveyed, via the slotted PVC pipe, to a vertical pipe stack for venting. A barrier layer/geomembrane was also installed beneath the building structure and incorporated into the vapor control system to prevent incidental gas flow into the building and prevent short-circuiting airflow from the ground surface. System schematics are provided in Appendix H.

6.1.1.3 Operation and Maintenance

The passive vapor control system requires no active operations and little maintenance other than periodic inspection of the stack pipe to ensure it is in good condition and free of obstructions.

6.1.2 ENHANCED LNAPL RECOVERY AND SEEP CONTROL SYSTEM**6.1.2.1 Objectives**

The overall goal of the LNAPL recovery system is to eliminate the potential exposure from the LNAPL seeps and control the offsite release of LNAPL.

Barrier wall and LNAPL recovery system details are provided below.

6.1.2.2 Description of System

To eliminate seeps, a steel sheet pile cut-off wall has been installed along a portion of the western bank of Phillips Island. Installation of the sheet pile cut-off wall was conducted by Commerce Construction Corporation between May 31 and June 17, 2002, under the oversight of URS. The approximate location of this barrier wall is shown on Figure 2.

The sheet pile cut-off wall was installed along the southwest edge of Philips Island. A total of 55 AZ-18 continuously-welded 'double-piles' with interlock sealant ('Roxan' system) from Skyline Steel were used to construct the approximately 227 feet long cut-off wall. Sheet piles were factory-coated with coal tar epoxy and delivered in lengths of 65 feet. All 55 piles were partially or fully driven using a vibratory hammer (ICE 44-65). URS construction oversight activities included materials inspection, sheet pile driving observation, and confirmation of proper installation techniques and alignments. Barrier wall supporting documentation is provided in Appendix I.

LNAPL recovery and control at Phillips Island is accomplished using three separate LNAPL recovery systems, designated the Western System, the Southern System and the Eastern System.

The Western system consists of fifteen (15) extraction wells located within the barrier wall, a pneumatic double diaphragm pump and a process logic controller. Total fluids recovered from the 15 wells is transferred to an oil/water separator located in a treatment shed east of Phillips Island. Water and oil are separated; the water is discharged to the refinery separator system and the LNAPL is transferred to a series of two 550 gallon holding tanks. The LNAPL recovery system was installed by refinery approved contractors in February 2004.

The Southern system consists of fifteen (15) extraction wells located along the southern shoreline of Phillips Island, two pneumatic double diaphragm pumps and a process logic controller. Five wells are pumped by the same pump that operates the Western System. Ten wells are pumped by another pneumatic double diaphragm pump located in the treatment shed with the oil/water separator. Total fluids recovered from the southern wells are transferred to the same treatment system described for the Western system.

The Eastern System consists of a six foot deep recovery trench running the length of a sheetpile retaining wall along the eastern side of Phillips Island. Total fluids are removed from the recovery trench using a dedicated pneumatic double diaphragm pump and a timer. Total fluids recovered from the Eastern System are transferred to the same treatment system described for the Western system. All recovered LNAPL is recycled by the refinery. All systems are detailed in Figures J-1 through J-4/Appendix J).

The LNAPL recovery wells were constructed of 4-inch diameter, schedule 40 PVC screen and casing. The annulus around each well screen was backfilled with clean sand to a height of 2 feet above the top of the well screen. An approximately 2-foot thick bentonite pellet seal was placed above the sand pack and a cement/bentonite grout was then placed in the remaining annulus up to grade. A pitless adapter has been fitted on each well to accommodate the subgrade PVC discharge pipe. Each western well is completed with a well vault flush with the grade. Each southern well is completed above grade.

Since the startup of the enhanced LNAPL recovery system in March 2004, Sunoco has recovered a total of approximately 3,900 gallons of LNAPL. This represents a recovery rate of approximately 400 gallons of LNAPL per month.

The area along the west bank of Phillips Island where the seeps were identified will be periodically inspected to monitor conditions (LNAPL seeps abating or continuing) or identify changes in the location of seeps. Further details on the seep inspections is provided in Section 6.1.3.3 below. If the seeps reappear after a period of absence, or appear in a new location, enhancing the LNAPL recovery system or extending the barrier will be evaluated. The evaluation may include an examination of alternative recovery systems, installing additional recovery wells, modifying well pumping rates and/or frequency, or installation of an extended or different barrier. Containment and absorbent booms are currently in the Delaware River to mitigate the release of LNAPL into the river. The booms are positioned along the loading docks at Phillips Island and effectively surround the area of seeps.

6.1.2.3 Operation and Maintenance

The LNAPL recovery system has been designed to operate unattended with routine inspection, monitoring, and maintenance. The bank and shoreline of the Delaware River will also be inspected for seeps.

The effectiveness and efficiency of the pumping system will be reviewed periodically to help assure it continues to operate in accordance with its intended purpose.

The containment and absorbent booms will be inspected weekly and immediately after a major storm event. Damage to the containment booms will be repaired or damaged booms will be replaced. The absorbent booms will be replaced if damaged or when the booms are at the end of their useful life.

The status of the LNAPL recovery and control system operation will be incorporated into the quarterly CRP progress reports.

6.1.3 STAINED SOIL REMOVAL AROUND THE WEST SEEP**6.1.3.1 Objective**

The objective of the stained soil removal was to eliminate a potential direct contact exposure pathway.

6.1.3.2 Remedial Action Description

The area of stained soil measured approximately 10 feet by 10 feet and was located down-slope of the seep near the top of the west bank. The stained soil was approximately 12 feet above the high water line and was unaffected by the tidal cycle which contacts the stones and rocks along the shoreline.

Direct contact with impacted surface soil has been addressed by removing impacted soil. The impacted soil was removed during area preparations prior to sheet pile wall installation.

6.1.3.3 Operation and Maintenance

During the routine weekly inspections of the former seeps, the area of soil remediation will be inspected for evidence of erosion. The area will be repaired on an as-needed basis. Should a LNAPL seep reappear, corrective measures will be evaluated and implemented to address the seep and impacted soil.

6.1.4 STORMWATER CONTROL/INFILTRATION MINIMIZATION**6.1.4.1 Objective**

Although the remedial investigation indicated that site materials have a very low permeability and that the potential for surface water infiltration is very low, a stormwater collection system further minimizes or eliminates the potential for stormwater to contact the waste material via surface flow or infiltration. Therefore, the objective of the stormwater control/infiltration minimization system is to minimize stormwater infiltration to impacted surface and subsurface media.

6.1.4.2 Remedial Action Description

Stormwater infiltration minimization has been addressed by construction of a stormwater collection system designed to collect all stormwater from the site (except for that falling on the banks of the Delaware River). The collection system was installed by FPLE contractors between 2002 and 2004 during construction of the co-generation facility. Diagrams detailing the stormwater control system are provided in Appendix K.

The surface of the site is covered either with asphalt or gravel except for the banks along the Delaware River. The areas paved with asphalt direct surface runoff into catch basins. Catch basins in areas that potentially have oil or grease are connected with reinforced concrete pipe to an oil/water separator. Surface water in gravel areas drains to perforated pipes that convey the water to an oil/water separator. Water collected in separators and catch basins is conveyed to the co-generation station cooling towers for use as make-up water for the non-contact cooling system. Details regarding the stormwater collection system were determined from diagrams provided to URS from FPLE.

6.1.4.3 Operation and Maintenance

The integrity of the asphalt and gravel cover will be maintained to capture all stormwater on the site. If earthwork is required in the future, the stormwater collection system will be reconstructed to maintain the integrity of the system. Catch basins and piping will be cleaned on an as needed basis.

6.2 SAMPLING AND ANALYSIS

The effectiveness of the remedial action is based on the presence/absence of LNAPL in seeps along the Delaware River, the elimination of the direct contact exposure pathway, and the elimination of the inhalation exposure pathway. The groundwater potential exposure pathway is incomplete as no potential receptors were identified within at least 0.5 mile of the site. Therefore, no sampling or analyses are necessary.

6.3 LIST OF CONTACTS

Project Manager: James Oppenheim, P.E.
Sunoco, Inc. (R&M)
100 Green Street
Marcus Hook, PA 19061
Telephone: 610-859-1881

Environmental Consultant: Glenn C. Randall, P.G.
URS Corporation
335 Commerce Drive, Suite 300
Fort Washington, PA 19034
Telephone: 215-367-2500

7.1 ATTAINMENT OF SITE-SPECIFIC STANDARD

Table 2 presents a list of compounds meeting Non-Residential Used Aquifer Statewide Health Standards and Site-Specific Standards.

7.1.1 SOILS

For soil and vapors, the potential direct contact and inhalation exposure pathways have been eliminated through engineering controls including installation of vapor barriers, surface capping, and impacted soil removal.

7.1.2 GROUNDWATER

The potential exposure pathways for surface water and groundwater have been eliminated through engineering controls including impacted soil removal, installation of the sheetpile barrier wall and the enhanced LNAPL recovery system, and stormwater management. In addition, the results of the fate and transport analysis indicated that dissolved compounds in site groundwater will not discharge to the Delaware River at concentrations above the surface water quality criteria. Furthermore, no potential onsite exposure pathway for groundwater exists because groundwater occurs under semi-confined conditions at no less than 15 feet bgs, and groundwater is not currently used or planned for use at the site. Control of LNAPL migration and elimination of potential direct contact exposure to LNAPL has also been accomplished through installation of the subsurface sheetpile barrier wall and active LNAPL recovery to eliminate seeps. Potential inhalation exposure pathways for vapors from groundwater and/or LNAPL have been eliminated through installation of vapor barriers at occupied onsite buildings.

As a result, the site-specific standard for groundwater through pathway elimination via implementation of engineering controls and demonstration of acceptable risk (through diffuse flow of dissolved compounds) has been attained.

7.2 DEMONSTRATION OF ATTAINMENT SUMMARY

The demonstration of attainment for each remedial action is summarized as follows:

Remedial Action	Results and Act 2 Standard Attained
Installation of passive vapor control system beneath occupied site buildings	Site conditions meet applicable site-specific standards via elimination of pathway of vapors from soil and groundwater/LNAPL to occupied buildings.
Installation of subsurface barrier wall and integrated enhanced LNAPL recovery system	<ul style="list-style-type: none">• Control of LNAPL migration• LNAPL being recovered Site conditions meet applicable site-specific standards via elimination of pathway of

	direct contact exposure by potential human and ecological receptors to groundwater/LNAPL, and impacts to surface water.
Removal of impacted soil from around the seep near the top of the west bank of the berm and replacement with clean soil and gravel	Site conditions meet applicable site-specific standards via elimination of pathway of direct contact exposure by potential human and ecological receptors to impacted surface soil at seep.
Installation of stormwater control and infiltration minimization system including asphalt surfaces and collection and conveyance system	Eliminates potential offsite migration of impacted soil/sediments, eliminates impacted stormwater runoff due to surface soil contact, and minimizes stormwater infiltration and mobilization of subsurface constituents
Capping of site with clean soil, gravel, asphalt, concrete, and building structures	Elimination of soil direct contact exposure pathway by potential human and ecological receptors. Attainment of applicable site-specific standards via elimination of pathway.

A more detailed discussion of the demonstration of attainment for each of the site media is further summarized in Figure 12.

This post-remediation care plan has been prepared to ensure that Act 2 requirements for Site soils are maintained in the future consistent with the attainment demonstration set forth in this Final Report. This plan describes the institutional and engineering controls that will be implemented and the method of documenting these post-remediation care obligations in compliance with Act 2 requirements.

8.1 SUBSTANTIVE POST-REMEDIAL CARE REQUIREMENTS

The engineering controls in place at the Site consist of:

- LNAPL recovery system;
- Passive vapor control system;
- Stormwater management; and
- Sheetpile cutoff wall.

These engineering controls will continue to be operated as a means to control LNAPL and regulated substances remaining in the subsurface soil and groundwater that have the potential to impact surface water and soil vapor at unacceptable concentrations. As described in this Final Report, these engineering controls are effectively preventing impact to potential receptors.

The LNAPL recovery systems are monitored on a bi-weekly basis and groundwater monitoring of selected wells is performed on a quarterly basis. System operational data and the monitoring data is submitted to PADEP in a quarterly report.

Groundwater at this Site will not be used for drinking water or agricultural purposes.

8.2 NOTICE OF POST-REMEDIAL CARE REQUIREMENTS AND DEED ACKNOWLEDGMENT

In February 1996, as part of the RCRA closure of the Middle Creek surface impoundment, a deed notice (Amendment to Deed) was generated for all deeds associated with the Marcus Hook refinery property, including Phillips Island. A copy of the deed notice (Grantee's Amendment to Deed) is provided as Appendix L. As indicated in the Amendment to Deed:

"Pursuant to Section 265.119(b) of the U.S. Environmental Protection Agency Hazardous Waste Regulations (40 C.F.R. Part 265, Subpart G) and Section 265.119(b) of the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations (25 Pa. Code Chapter 265, Subchapter G), this Amendment is to provide the following notice to the Deeds listed above:

1. Land covered by to the aforementioned Deeds has been used to manage hazardous wastes;
2. The use of this land is restricted under the U.S. Environmental Protection Agency Hazardous Waste Regulations, 40 C.F.R. Part 265, Subpart G, and the Pennsylvania

Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.117(c); and

3. The survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the hazardous waste disposal unit of the facility required by the U.S. Environmental Protection Agency Regulations, 40 C.F.R. 265.116 and 265.119(a), and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.119(a), has been filed with the Marcus Hook Borough, the Lower Chichester Township, the Pennsylvania Department of Environmental Protection, and the U.S. Environmental Protection Agency.”

In the event the property is transferred to a new owner, this Final Report, which acknowledges that a combination of non-residential SHS and SSS were attained at the Site, that the Site is limited to non-residential use, and which contains descriptions of the engineering controls and groundwater use restrictions applicable to the future use of the Site, will also be filed with the Marcus Hook Borough, the Lower Chichester Township, and the Pennsylvania Department of Environmental Protection.

Sunoco and the city of Marcus Hook received no comments from the public in response to the public Notification of Intent to Remediate and the notice of submittal of the July 2000 *Combined Report* to PADEP by Sunoco, which were published in the Delaware County Daily Times Newspaper in April and June 2, 2000, respectively.

SECTION TEN

SIGNATURES

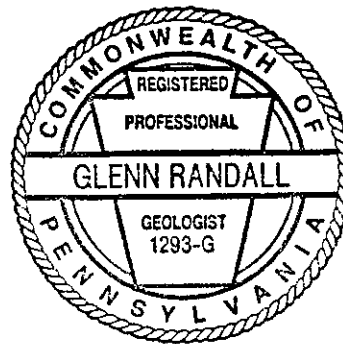
In accordance with the PADEP's Act 2 Technical Guidance Manual (PADEP, 2002), this section includes the signatures of the Environmental Consultant that prepared this Final Report. In accordance with the Notice of Intent to Remediate (NIR) that was submitted by Sunoco/URS to PADEP in April 2000, Sunoco is seeking an Act 2 relief of liability using the information presented in this and prior reports.

This report was prepared, on behalf of Sunoco, Inc. (R&M), by URS Corporation of Fort Washington, Pennsylvania.



Glenn C. Randall, PG-001293-G

Senior Project Manager



1. Sun Oil Company Internal Memorandum, January 13, 1992. *Subject: Narrative on Phillips Island.*
2. NUS Corporation Superfund Division, June 12, 1987. *Preliminary Assessment of Sun Oil Company Phillips Island Fill.*
3. ERM, Inc., February 1990. *Interim Report on Screening Study and Work Plan for Subsurface Investigation on Closed Waste Units at the Marcus Hook Refinery.*
4. ERM, Inc., October 1990. *Report on Subsurface Investigation of Closed Waste Units at the Sun Marcus Hook Refinery, Marcus Hook, Pennsylvania.*
5. A.T. Kearney, Inc., August 19, 1991. *Phase II Final RCRA Facility Assessment of the Sun Refining and Marketing Company (Formerly Sun petroleum Products Company) Marcus Hook Refinery, Marcus Hook, Pennsylvania.*
6. Sun Company, Inc. (R&M), 19 May 1995. *Addendum and Revision to the Marcus Hook Refinery Comprehensive Remedial Plan.*
7. Groundwater & Environmental Services, Inc., 28 July 1995. *Perimeter Groundwater Assessment, Area 9: Phillips Island.*
8. Groundwater & Environmental Services, Inc., 29 November 1995. *Perimeter Groundwater Assessment Addendum, Area 9: Phillips Island.*
9. Sun Company, Inc. (R&M), March 28, 1996. *Comprehensive Remedial Plan, Area 9 – Phillips Island.*
10. Pennsylvania Department of Environmental Protection, August 1996. Letter regarding WQ/IW Correspondence.
11. Sun Company, Inc. (R&M), October 31, 1996. *Marcus Hook Refinery Comprehensive Remedial Plan Quarterly Progress Report, Third Quarter 1996.*
12. Handex of Maryland, Inc., January 27, 2000. *Annual Sampling Program Status Report, Marcus Hook Refinery & #2 Tank Farm.*
13. Heath, Ralph C., 1982. *Basic Ground-Water Hydrology.* United States Geological Survey, Water Supply Paper 2220.
14. Bartoldus, C. C., E. W. Garbisch, and M. L. Kraus. 1994. *Evaluation for Planned Wetland (EPW).* Environmental Concern Inc., St. Michaels, Maryland. 327 pp. and appendices.
15. TNRCC, 1999. Texas Risk Reduction Program. Texas Natural Resource Conservation Commission.
16. TNRCC, 1997. Clarifications and Amendments for Implementation of RG-36. Technical Memorandum from Chet Clarke, Director of Programs, Petroleum Storage Tank Division Texas Natural resource Conservation Commission, to PST Corrective Action Coordinators. Memorandum dated March 6, 1997.
17. EPA, 1996. Soil Screening Guidance. User's Guide. PB96-963505.
18. EPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". OSWER Directive 9285.6-03.

TABLES

Table 1
Summary of Analytical Program
Sunoco Refinery-Phillips Island
Marcus Hook, Pennsylvania

Soil

Soil Borings B-PH1 through B-PH12 and MW-137 through MW-146

Volatile Organic Compounds (EPA Method 8260)

Semi-volatile Organic Compounds (EPA Method 8270)

Polychlorinated Biphenyls (EPA Method 8082)

Organochlorine Pesticides (EPA Method 8081)

Total Petroleum Hydrocarbons- gasoline range and diesel range organics

Total Metals- antimony, arsenic, barium, beryllium, cadmium, chromium, chromium (+6), copper, lead, nickel, selenium, silver, and zinc (EPA Method 6010)

Mercury (EPA Method 7470A)

Cyanide

Geoprobe Borings GP-PH1 through GP-PH15 and GP-51 through GP-56

Volatile Organic Compounds (EPA Method 8260)

Groundwater

Monitoring Wells MW-40, MW-118, and MW-137 through MW-146

Volatile Organic Compounds with cumene, ethylene dibromide, and methyl tertiary butyl ether (EPA Method 8260)

Semi-volatile Organic Compounds (EPA Method 8270)

Polychlorinated Biphenyls (EPA Method 8082)

Organochlorine Pesticides (EPA Method 8081)

Total Petroleum Hydrocarbons- gasoline range and diesel range organics

Dissolved Metals- arsenic, barium, cadmium, chromium, lead, selenium, and silver (EPA Method 6010)

Mercury (EPA Method 7470A)

Cyanide

Total Organic Carbon

Ammonia

Nitrogen (NO₂/NO₃)

Chloride

Sulfate

Fluoride

Total Dissolved Solids

Total Suspended Solids

Alkalinity

pH

Specific Conductance

LNAPL

LNAPL Samples B-PH10, MW-113, MW-115, MW-116, MW-119, MW-121, and MW-121A

Polychlorinated Biphenyls (EPA Method 8082)

Specific Gravity

LNAPL Sample MW-116

Fingerprinting

Volatile Organic Compounds (EPA Method 8260)

Semi-volatile Organic Compounds (EPA Method 8270)

TABLE 2
REMEDIATION STANDARDS ATTAINED BY COMPOUND
PHILLIPS ISLAND SITE
MARCUS HOOK, PENNSYLVANIA

SURFACE SOIL (0-2 feet bgs)
Compounds Meeting Non-Residential Direct Contact and Soil to Groundwater Non-Residential Used Aquifers (TDS ≤ 2500) MSCs

VOCs	SVOCs	Pesticides	Metals
1,2-Dichloroethane	2-Methylnaphthalene	4,4'-DDD	Arsenic
Acetone	Chrysene	4,4'-DDE	Barium
Benzene	Fluoranthene	4,4'-DDT	Beryllium
Carbon disulfide	Phenanthrene	delta-BHC	Cadmium
Chlorobenzene	Pyrene	Heptachlor epoxide	Chromium
Chloroform			Copper
Dichloromethane			Lead
Ethylbenzene			Mercury
Isopropyl Benzene			Nickel
Methyl ethyl ketone			Selenium
Methyl tertiary butyl ether			Zinc
Toluene			
Xylenes (Total)			

SURFACE SOIL (0-2 feet bgs)
Compounds Meeting Site-Specific Standards by Pathway Elimination

VOCs	SVOCs	Pesticides	Metals
	2,4-Dichlorophenol	Aldrin	
	2,4-Dinitrophenol	alpha-BHC	
	2,4-Dinitrotoluene	beta-BHC	
	2,6-Dinitrotoluene	Dieldrin	
	2-Chlorophenol	gamma-BHC	
	2-Nitroaniline	Heptachlor	
	3-Nitroaniline	Toxaphene	
	4-Nitroaniline		
	4-Nitrophenol		
	Aniline		
	Bis(2-chloroethyl)ether		
	Bis(2-ethylhexyl)phthalate		
	Hexachlorobenzene		
	Hexachlorobutadiene		
	Hexachloroethane		
	Isophorone		
	n-Nitroso-di-propylamine		
	Nitrobenzene		
	Pentachlorophenol		

TABLE 2
REMEDIATION STANDARDS ATTAINED BY COMPOUND
PHILLIPS ISLAND SITE
MARCUS HOOK, PENNSYLVANIA

SUBSURFACE SOIL (>2 feet bgs)

Compounds Meeting Non-Residential Direct Contact (2-15 feet bgs) and Soil to Groundwater Non-Residential Used Aquifers (> 2 feet bgs & TDS ≤ 2500) MSCs

VOCs	SVOCs	Pesticides/PCBs	Metals
Acetone	2-Methylnaphthalene	4,4'-DDD	Arsenic
Bromomethane	Anthracene	4,4'-DDE	Barium
Carbon disulfide	Benzo(a)pyrene	4,4'-DDT	Beryllium
Chloroethane	Benzo(b)fluoranthene	beta-BHC	Cadmium
Chloroform	Benzo(g,h,i)perylene	delta-BHC	Chromium
1,1-Dichloroethane	Bis(2-ethylhexyl) phthalate	Dieldrin	Copper
Ethylbenzene	Chrysene	Heptachlor epoxide	Mercury
Isopropyl Benzene	Fluoranthene	Aroclor-1016	Nickel
Methyl ethyl ketone		Aroclor-1260	Silver
Toluene			Zinc
Xylenes (Total)			Cyanide Total
Chlorobenzene			
Methyl tertiary butyl ether			

SUBSURFACE SOIL (>2 feet bgs)

Compounds Meeting Site-Specific Standards by Pathway Elimination

VOCs	SVOCs	Pesticides	Metals & Other
Benzene	1,2,4-Trichlorobenzene	alpha-BHC	Lead
Dichloromethane	1,2-Dichlorobenzene		Selenium
1,1,2,2-Tetrachloroethane	1,3-Dichlorobenzene		TPH Diesel
1,1,2-Trichloroethane	1,4-Dichlorobenzene		TPH/GRO
1,1-Dichloroethylene	2,4-Dichlorophenol		
1,2-Dichloroethane	2,4-Dinitrophenol		
1,2-Dichloropropane	2,4-Dinitrotoluene		
4-Methyl-2-pentanone	2,4,6-Trichlorophenol		
Bromodichloromethane	2,6-Dinitrotoluene		
Carbon tetrachloride	2-Chlorophenol		
Chloromethane	2-Nitroaniline		
cis-1,2-Dichloroethylene	3-Nitroaniline		
Styrene	3,3'-Dichlorobenzidine		
Tetrachloroethylene	4-Chloroaniline		
trans-1,2-Dichloroethylene	4-Nitroaniline		
Trichloroethylene	4-Nitrophenol		
Vinyl chloride	Aniline		
	Bis(2-chloroethyl)ether		
	Bis(2-chloroisopropyl) ether		
	Hexachlorobenzene		
	Hexachlorobutadiene		
	Hexachlorocyclopentadiene		
	Hexachloroethane		
	Isophorone		
	n-Nitroso-di-propylamine		
	n-Nitrosodiphenylamine		
	Naphthalene		
	Nitrobenzene		
	Pentachlorophenol		
	Phenanthrene		
	Pyrene		

Remainder of the compounds analyzed for in soils but not listed above were not detected at the site.

TABLE 2
REMEDIATION STANDARDS ATTAINED BY COMPOUND
PHILLIPS ISLAND SITE
MARCUS HOOK, PENNSYLVANIA

GROUNDWATER

Compounds Meeting Non-Residential Used Aquifers (TDS \leq 2500) MSCs (without demonstrating attainment)

VOCs	SVOCs	Pesticides	Metals & Other
1,1,2,2-Tetrachloroethane	2,4-Dichlorophenol	4,4'-DDD	Barium
1,1,2-Trichloroethane	2,4-Dinitrophenol	alpha-BHC	Chromium III
1,1-Dichloroethane	2-Chlorophenol		Mercury
1,2-Dichloropropane	2-Methylnaphthalene		Fluoride
2-Hexanone	4-Chloro-3-methylphenol		Nitrogen NO3-N
Acetone	4-Methylphenol		Sulfate
Tribromomethane	4-Nitrophenol		
Carbon disulfide	Hexachlorocyclopentadiene		
Carbon tetrachloride	Phenol		
Chloromethane			
cis-1,3-Dichloropropene			
Ethylbenzene			
Methyl ethyl ketone			
Tetrachloroethylene			
Toluene			
trans-1,3-Dichloropropene			
Vinyl chloride			
Xylenes (Total)			

GROUNDWATER

Compounds Meeting Site-Specific Standards by Pathway Elimination

VOCs	SVOCs	Pesticides	Metals & Other
Benzene	2,4-Dinitrotoluene	Endrin ketone	Arsenic
Bromoform	2-Nitroaniline		Cadmium
Dichloromethane	3,3'-Dichlorobenzidine		Fluoride
Methyl tertiary butyl ether	3-Nitroaniline		Lead
Trichloroethylene	4-Nitroaniline		Selenium
	Aniline		Alkalinity
	Benzo(a)pyrene		Chloride
	Benzo(b)fluoranthene		Nitrogen NH3-N
	Benzo(k)fluoranthene		TPH Diesel
	Benzo(a)anthracene		TPH/GRO
	Benzo(g,h,i)perylene		
	Bis(2-chloroethyl)ether		
	Bis(2-ethylhexyl)phthalate		
	Chrysene		
	Dibenz(a,h)anthracene		
	Hexachlorobenzene		
	Hexachlorobutadiene		
	Hexachloroethane		
	Indeno(1,2,3-cd)pyrene		
	n-Nitroso-di-propylamine		
	Pentachlorophenol		

Remainder of the compounds analyzed for in groundwater but not listed above were not detected at the site.

TABLE 3

Summary of Groundwater Elevations
Sunoco Refinery-Phillips Island
Marcus Hook, Pennsylvania

Well	Date	Casing Elevation (Feet)	Depth to Groundwater (Feet)	Depth to LNAPL (Feet)	Groundwater Elevation (Feet)	Apparent LNAPL Thickness (Feet)	LNAPL Specific Gravity
MW-40	April 26, 2000	12.91	4.02		8.89		
	March 15, 2000		4.29		8.62		
	February 25, 2000		4.40		8.51		
MW-113	April 26, 2000	13.62	9.06	8.45	4.56	0.61	
	March 15, 2000		9.61	7.67	4.01	1.94	
	February 23, 2000		11.90	10.03	2.57	1.87	0.92
MW-114	April 26, 2000	13.59	8.27	7.56	5.32	0.71	
	March 15, 2000		-		-		
	February 23, 2000		8.73	8.70	4.86	0.03	
MW-115	April 26, 2000	25.68	14.11	13.61	11.57	0.50	
	March 15, 2000		18.13	17.56	7.55	0.57	
	February 23, 2000		17.79	16.60	8.77	1.19	0.94
MW-116	April 26, 2000	24.97	22.21	21.94	2.76	0.27	
	March 15, 2000		27.22	26.66	-2.25	0.56	
	February 22, 2000		23.00	20.00	2.83	3.00	0.93
MW-117	April 26, 2000	25.83	17.97	12.11	7.86	5.86	
	March 15, 2000		12.05	11.31	13.78	0.74	
	February 23, 2000		12.40	12.30	13.43	0.10	
MW-118	April 26, 2000	21.05	8.04		13.01		
	March 15, 2000		8.58		12.47		
	February 25, 2000		8.09		12.96		
MW-119	April 26, 2000	27.12	-	-	-		
	March 15, 2000		-	-	-		
	February 22, 2000		29.35	23.00	-1.38	6.35	0.92
MW-121	April 26, 2000	28.30	-	5.80	-		
	March 15, 2000		-	5.54	-		
	February 23, 2000		8.87	5.80	20.29	3.07	0.93
MW-121A	April 26, 2000	28.76	5.79	5.71	22.97	0.08	
	March 15, 2000		5.42	5.33	23.34	0.09	
	February 23, 2000		6.20	5.05	23.41	1.15	0.92
MW-137	April 26, 2000	19.22	11.65		7.57		
	March 15, 2000		12.19		7.03		
MW-138	April 26, 2000	20.01	12.36		7.65		
	March 15, 2000		12.97		7.04		
MW-139	April 26, 2000	22.91	15.12		7.79		
	March 15, 2000		15.76		7.15		
MW-140	April 26, 2000	17.80	10.03		7.77		
	March 15, 2000		10.67		7.13		
MW-141	April 26, 2000	12.83	6.91		5.92		
	March 15, 2000		8.19		4.64		

TABLE 3

Summary of Groundwater Elevations
Sunoco Refinery-Phillips Island
Marcus Hook, Pennsylvania

Well	Date	Casing Elevation (Feet)	Depth to Groundwater (Feet)	Depth to LNAPL (Feet)	Groundwater Elevation (Feet)	Apparent LNAPL Thickness (Feet)	LNAPL Specific Gravity
MW-142	April 26, 2000	24.78	19.21		5.57		
	March 15, 2000		19.85		4.93		
MW-143	April 26, 2000	24.91	20.84		4.07		
	March 15, 2000		27.85		-2.94		
MW-144	April 26, 2000	26.18	18.12		8.06		
	March 15, 2000		19.61		6.57		
MW-145	April 26, 2000	31.51	23.83		7.68		
	March 15, 2000		24.47		7.04		
MW-146	April 26, 2000	13.68	5.56		8.12		
	March 15, 2000		6.04		7.64		

Notes:

Depth to Groundwater Measured from Top of Inner Casing

Elevations determined relative to a site-specific datum

LNAPL = Light non-aqueous phase liquid

Groundwater elevations have been corrected for the presence of LNAPL using well-specific analytical results for LNAPL specific gravity (0.92 - 0.94). A default value of 0.90 was used when specific gravity information was unavailable for MW-114 and MW-117.

Depth to groundwater and/or LNAPL could not be measured from MW-119 or MW-121 on April 26, 2000 due to obstruction from downhole LNAPL recovery equipment.

TABLE 4A**SUMMARY OF COMPOUNDS DETECTED IN GROUNDWATER
ABOVE THE NON-RESIDENTIAL USED AQUIFER MSC****PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA****Sampling Event: February 23-25, 2000**

Compound	No. Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Volatile Organic Compounds (ug/l)						
Benzene	12	2	6	50	28	28
Dichloromethane*	12	1	20	20	20	20
Methyl tertiary butyl ether	12	2	51	120	85	85
Semi-volatile Organic Compounds (ug/l)						
4-Methylphenol (Cresol)	12	1	220	220	220	220
Bis (2-ethylhexyl)phthalate**	12	3	12.0	33.0	22.5	19.3
Metals (mg/l)						
Arsenic	12	7	0.051	1.30	0.68	0.33
Cadmium	12	1	0.007	0.007	0.007	0.007
Lead	12	4	0.008	0.073	0.04	0.03

*- Dichloromethane (methylene chloride) is a common laboratory contaminant and was detected in the equipment blanks at concentrations up to 10 ug/l.

** - Bis (2-ethylhexyl) phthalate is a common laboratory contaminant and was detected in the equipment blank at concentration of 40 ug/l. Therefore, the actual presence of this compound is highly suspect.

TABLE 4B**SUMMARY OF COMPOUNDS DETECTED IN GROUNDWATER
ABOVE THE NON-RESIDENTIAL USED AQUIFER MSC****PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA****Sampling Event: April 27, 2000**

Compound	No. Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Volatile Organic Compounds (ug/l)						
Benzene	12	2	6	36	21	21
Dichloromethane	12	3	6	11	12	8
Methyl tertiary butyl ether	12	2	66	93	79	79
Trichloroethylene	12	1	48	48	48	48
Semi-volatile Organic Compounds (ug/l)						
4-Methylphenol (Cresol)	12	1	140	140	140	140
Bis (2-ethylhexyl)phthalate	12	1	40	40	40	40
Metals (mg/l)						
Arsenic	12	6	0.068	1.4	0.73	0.58
Cadmium	12	2	0.01	0.014	0.012	0.012
Lead	12	8	0.006	0.41	0.208	0.076
Selenium	12	12	0.1	0.18	0.14	0.12

TABLE 4C**SUMMARY OF COMPOUNDS DETECTED IN SOIL PORE WATER
ABOVE THE NON-RESIDENTIAL USED AQUIFER MSC****PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA****Sampling Event: April 27, 2000**

Compound	No. Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Volatile Organic Compounds (ug/l)						
Benzene	6	4	6	240	123	80
Semi-volatile Organic Compounds (ug/l)						
Bis (2-ethylhexyl)phthalate	6	4	470	3200	1835	1715
Metals (mg/l)						
Cadmium	6	3	0.006	0.013	0.009	0.008
Lead	6	1	0.008	0.008	0.008	0.008
Selenium	6	6	0.15	0.25	0.20	0.195

TABLE 5A

**SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS
FEBRUARY 25, 2000 GROUNDWATER SAMPLING ROUND - VOCs**

**SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA**

Parameter	Non Residential Used Aquifers*	Location Sample ID Sample Date Unit	MW-40 MW-40 2/25/00	MW-118 MW-118 2/25/00	MW-137 MW-3 2/24/00	MW-138 MW-4 2/24/00	DUP 2/24/00	MW-139 MW-6 2/24/00	MW-140 MW-2 2/23/00	MW-141 MW-1 2/23/00	MW-142 MW-11 2/24/00	MW-143 MW-8 2/24/00	MW-144 MW-9 2/24/00	MW-145 MW-5 2/24/00	MW-146 MW-10 2/24/00
1,1,2,2-Tetrachloroethane	0.3 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1,2-Trichloroethane	5 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,1-Dichloroethane	110 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.6	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
1,2-Dichloropropane	5 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
2-Hexanone	UG/L	10U	5U	10U	50U	5U	5U	12U	5U	5U	5U	5U	5U	5U	5U
Acetone	10,000 UG/L	8J	7	8J	50U	4J	3J	12U	4J	28	2J	41	21	2J	5J
Benzene	5 UG/L	50	0.5 U	50	5U	0.5 J	0.6	1U	3	6	1	0.5 U	0.5 U	0.5 U	0.5 U
Bromoform	UG/L	2U	1U	2U	10U	1U	1U	2U	1U	1U	1U	1U	1U	1U	1U
Tribromomethane	UG/L	2U	1U	2U	10U	1U	1U	2U	1U	1U	1U	1U	1U	1U	1U
Carbon disulfide	4,100 UG/L	4	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.9	2	0.8	5	0.5 U	0.5 J
Carbon tetrachloride	5 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Chloromethane	3 UG/L	2U	1U	2U	10U	1U	1U	2U	1U	1U	1U	1U	1U	1U	1U
cis-1,3-Dichloropropene	UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Dichloromethane	5 UG/L	0.8 JB	0.5 U	1JB	20B	2B	1B	4B	2B	1U	2B	0.6 JB	0.7 JB	0.8 JB	1U
Ethylbenzene	700 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 J	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl ethyl ketone	5,800 UG/L	5U	10U	10U	50U	5U	5U	12U	5U	9	5U	9	5U	5U	5U
Methyl tertiary butyl ether	20 UG/L	1U	0.5 U	1U	120	2	2	51	2	0.8	0.5 U	0.5 U	1	2	0.5 U
o-Xylene	UG/L	1U	0.5 U	1U	5U	0.9	1	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Tetrachloroethylene	5 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	18	0.5 U	0.5 U
trans-1,3-Dichloropropene	UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Trichloroethylene	5 UG/L	1U	0.5 U	1U	5U	0.5 U	0.5 U	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Vinyl chloride	2 UG/L	1U	1U	2U	10U	1U	1U	2U	1U	1U	1U	1U	1U	1U	1U
Xylenes(Total)	10,000 UG/L	1U	0.5 U	1U	5U	1	2	1U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

-exceeds MSC

TABLE 5A

SUMMARY WATER SAMPLE ANALYTICAL RESULTS
APRIL 27, 2000 GROUNDWATER SAMPLING ROUND - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample ID Sample Date Unit	MW-118 4/27/2000	MW-117 4/27/2000	MW-138 4/27/2000	MW-139 4/27/2000	MW-139 Dup 0427/2000	MW-140 4/27/2000	MW-141 4/27/2000	MW-142 4/27/2000	MW-143 4/27/2000	MW-144 4/27/2000	MW-145 4/27/2000	MW-146 4/27/2000	MW-40 4/27/2000
1,2-Dichloropropane		5 ug/L	1 U	2 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Acetone	10,000	ug/L	10 J	25 U	5 U	12 U	5 U	5 U	46	5	40	28	8	5 U	5 U
Benzene		5 ug/L	36	2 U	0.5 J	1 U	0.5 U	0.4 J	6	0.4 J	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Carbon disulfide	4,100	ug/L	1 U	2 U	0.5 U	1 J	1	0.7	4	28	4	39	42	0.9	0.8
Chloromethane		3 ug/L	2 U	5 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U
cis-1,2-Dichloroethylene	70	ug/L	1 U	2 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	3	0.5 U	0.5 U
Dichloromethane		5 ug/L	2 U	5 U	1 U	2 U	1 U	1 U	6	11	1 U	7	1 U	1 U	1 U
Ethylbenzene	700	ug/L	1 U	2 U	0.4 J	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Methyl tertiary butyl ether	20	ug/L	1 U	93	0.5 U	66	76 D	3	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
o-Xylene		ug/L	1 U	2 U	0.9	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U
Toluene	1,000	ug/L	1 U	2 U	0.5 J	1 U	0.8	0.6	0.6	0.5 U	0.5 J	4	0.5 U	0.5 U	0.5 U
Trichloroethylene		5 ug/L	1 U	2 U	0.5 U	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	48	0.5 U	0.5 U
Xylenes(Total)	10,000	ug/L	1 U	2 U	2	1 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U	0.5 U

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

=exceeds MSC

TABLE 5A

SUMMARY WATER SAMPLE ANALYTICAL RESULTS - SOIL PORE WATER VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample ID Sample Date Unit	MW-113 MW-113 4/27/2000	MW-114 MW-114 4/27/2000	MW-115 MW-115 4/27/2000	MW-116 MW-116 4/27/2000	MW-117 MW-117 4/27/2000	MW-121 MW-121 4/27/2000
Acetone	10,000	ug/L	9	4 J	14	130	6	50 U
Benzene	5	ug/L	0.5 U	10	60	6	4	240
Chloromethane	3	ug/L	1 U	1 U	2 U	5 U	1 U	10 U
Dichloromethane	5	ug/L	3	1 U	2 J	4 J	1	10 U
Ethylbenzene	700	ug/L	0.5 U	0.5 U	1	2 U	0.5 U	5 U
o-Xylene		ug/L	0.5 U	0.5 U	2	2 U	0.5 U	5 U
Toluene	1,000	ug/L	1	0.5 J	2	2 J	0.5 J	6
Vinyl chloride	2	ug/L	1 U	1 U	2 U	5 U	1 U	10 U
Xylenes(Total)	10,000	ug/L	0.6	0.9	3	2 U	0.5 J	5 U

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

=exceeds MSC

SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS
FEBRUARY 25, 2000 GROUNDWATER SAMPLING ROUND - SVOCs
SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers	Location Sample ID Sample Date	Unit	MW-40 2/25/00	MW-118 2/25/00	MW-137 2/24/00	MW-138 2/24/00	MW-138 DJP 2/24/00	MW-139 2/24/00	MW-140 2/23/00	MW-141 2/23/00	MW-142 2/24/00	MW-143 2/24/00	MW-144 2/24/00	MW-145 2/24/00	MW-146 2/24/00
2,4-Dichlorophenol	20	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2,4-Dinitrophenol	41	UG/L	120 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2,4-Dinitrotoluene	8.4	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Chlorophenol	40	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylnaphthalene	2,000	UG/L	50 U	10 U	6 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
2-Methylphenol (O-cresol)	5100	UG/L	50 U	10 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
2-Nitroaniline	5.8	UG/L	120 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
3,3'-Dichlorobenzidine	5.8	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
3-Nitroaniline	5.8	UG/L	120 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4,6-Dinitro-2-methylphenol	510	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chloro-3-methylphenol	510	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Chlorophenyl phenyl ether	2.1	UG/L	120 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
4-Methylphenol	60	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
4-Nitroaniline	66	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Aniline	0.2	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)pyrene	1.2	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(b)fluoranthene	0.55	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(k)fluoranthene	3.6	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(a)anthracene	0.26	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Benzo(g,h,i)perylene	0.55	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethoxy)methane	6	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-chloroethoxy)ether	1.9	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Bis(2-ethylhexyl) phthalate	0.36	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Chrysene	0.36	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenz(a,h)anthracene	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dibenzofuran	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Dimethyl phthalate	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobenzene	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorobutadiene	50	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachlorocyclopentadiene	3.6	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Hexachloroethane	0.37	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Indeno(1,2,3-cd)pyrene	100	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
n-Nitroso-di-propylamine	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Naphthalene	1	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
p-Bromodiphenyl ether	1	UG/L	120 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U	25 U
Pentachlorophenol	4,000	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U
Pyrene	130	UG/L	50 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

-exceeds MSC

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

TABLE 5B

SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS -
APRIL 27, 2000 GROUNDWATER SAMPLING ROUND - SVOCs
SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample ID Sample Date Unit	MW-118 MW-118 4/27/2000	MW-137 MW-137 4/27/2000	MW-138 MW-138 4/27/2000	MW-139 MW-139 4/27/2000	MW-139 Dup 042700 4/27/2000	MW-140 MW-140 4/27/2000	MW-141 MW-141 4/27/2000	MW-142 MW-142 4/27/2000	MW-143 MW-143 4/27/2000	MW-144 MW-144 4/27/2000	MW-145 MW-145 4/27/2000	MW-146 MW-146 4/27/2000	MW-40 MW-40 4/27/2000
2,4-Dichlorophenol	20 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
2,4-Dinitrophenol	41 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
2,4-Dinitrotoluene	8.4 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
2-Chlorophenol	40 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
2-Nitroaniline	5.8 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
3,3'-Dichlorobenzidine	5.8 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
3-Nitroaniline	5.8 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
4-Methylphenol	510 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	140	50 U	50 U	50 U	50 U	50 U	10 U
4-Nitroaniline	2.1 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
4-Nitrophenol	60 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
Aniline	5.8 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Anthracene	66 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzo(a)pyrene	0.2 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzo(b)fluoranthene	1.2 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzo(k)fluoranthene	0.55 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzo(a)anthracene	3.6 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzo(g,h,i)perylene	0.26 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Benzoic acid	410,000 ug/L	250 U	250 U	250 U	250 U	250 U	250 U	250 U	130 J	250 U	250 U	250 U	250 U	250 U	50 U
Bis(2-chloroethyl)ether	0.55 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Bis(2-ethylhexyl) phthalate	6 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	26 J	50 U	50 U	40 J	50 U	10 U
Chrysene	1.9 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Dibenz(a,h)anthracene	0.36 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Hexachlorobenzene	1 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Hexachlorobutadiene	1 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Hexachloroethane	1 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Indeno(1,2,3-cd)pyrene	3.6 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
n-Nitroso-di-propylamine	0.37 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Naphthalene	100 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U
Pentachlorophenol	1 ug/L	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	120 U	25 U
Phenol	4,000 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	370	50 U	200	94	50 U	50 U	10 U
Pyrene	130 ug/L	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	10 U

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

=exceeds MSC

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

TABLE 5B

SUMMARY WATER SAMPLE ANALYTICAL RESULTS - SOIL PORE WATER SVOCs
SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample Date Unit	MW-113 4/27/2000	MW-114 4/27/2000	MW-115 4/27/2000	MW-116 4/27/2000	MW-117 4/27/2000	MW-121 4/27/2000
1,2,4-Trichlorobenzene	70 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
1,2-Dichlorobenzene	600 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
1,3-Dichlorobenzene	600 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
1,4-Dichlorobenzene	75 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2,4,6-Trichlorophenol	31 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2,4-Dichlorophenol	20 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2,4-Dinitrophenol	41 ug/L		1200 U	1200 U	2500 U	2500 U	2500 U	2500 U
2,4-Dinitrotoluene	8.4 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2,6-Dinitrotoluene	100 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2-Chlorophenol	40 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2-Methylphenol (O Cresol)	5100 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
2-Nitroaniline	5.8 ug/L		1200 U	1200 U	2500 U	2500 U	2500 U	2500 U
3,3'-Dichlorobenzidine	5.8 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
3-Nitroaniline	5.8 ug/L		1200 U	1200 U	2500 U	2500 U	2500 U	2500 U
4-Chloroaniline	410 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
4-Nitroaniline	2.1 ug/L		1200 U	1200 U	2500 U	2500 U	2500 U	2500 U
4-Nitrophenol	60 ug/L		1200 U	1200 U	2500 U	2500 U	2500 U	2500 U
Aniline	5.8 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Anthracene	66 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Benzo(a)pyrene	0.2 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Benzo(b)fluoranthene	1.2 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Benzo(k)fluoranthene	0.55 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Benzo[a]anthracene	3.6 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Benzo[g,h,i]perylene	0.26 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Bis(2-chloroethyl)ether	0.55 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Bis(2-chloroisopropyl) ether	300 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Bis(2-ethylhexyl) phthalate	6 ug/L		500 U	470 J	2500	690 J	1000 U	3200
Chrysene	1.9 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Dibenz(a,h)anthracene	0.36 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Fluoranthene	270 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Fluorene	1900 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Hexachlorobenzene	1 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Hexachlorobutadiene	1 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Hexachlorocyclopentadiene	50 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Hexachloroethane	1 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U
Indeno(1,2,3-cd)pyrene	3.6 ug/L		500 U	500 U	1000 U	1000 U	1000 U	1000 U

TABLE 5B

SUMMARY WATER SAMPLE ANALYTICAL RESULTS - SOIL PORE WATER SVOCs
SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample ID Sample Date	Unit	MW-113	MW-114	MW-115	MW-116	MW-117	MW-121
				4/27/2000	4/27/2000	4/27/2000	4/27/2000	4/27/2000	4/27/2000
Isophorone	100	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
n-Nitroso-di-propylamine	0.37	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
n-Nitrosodiphenylamine	530	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
Naphthalene	100	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
Nitrobenzene	51	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
p-Bromodiphenyl ether	1	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
Pentachlorophenol	1,100	ug/L	1200 U	1200 U	2500 U	2500 U	2500 U	2500 U	2500 U
Phenanthrene	4,000	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
Phenol	130	ug/L	500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U
Pyrene			500 U	500 U	1000 U	1000 U	1000 U	1000 U	1000 U

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

=exceeds MSC

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds.

TABLE 5C

SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS
FEBRUARY 25, 2000 GROUNDWATER SAMPLING ROUND - PESTICIDES

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers	Location Sample ID Sample Date Unit	MW-40 MW-40 2/25/00	MW-118 MW-118 2/25/00	MW-138 MW-138 2/24/00	MW-137 MW-3 2/24/00	MW-138 DUP 2/24/00	MW-139 MW-6 2/24/00	MW-140 MW-2 2/23/00	MW-141 MW-1 2/23/00	MW-142 MW-11 2/24/00	MW-143 MW-8 2/24/00	MW-144 MW-9 2/24/00	MW-145 MW-5 2/24/00	MW-146 MW-10 2/24/00
4,4'-DDD	2.7	UG/L	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.02 U	0.04	0.02 U	0.02 U	0.06	0.02 U	0.02 U	0.28
alpha-BHC	0.41	UG/L	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.06
alpha-Chlordane		UG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endrin aldehyde		UG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U
Endrin ketone		UG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.05
gamma-Chlordane		UG/L	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U	0.04 U

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/L = microgram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

TABLE 5D

SUMMARY OF WATER SAMPLE ANALYTICAL RESULTS
FEBRUARY 25, 2000 GROUNDWATER SAMPLING ROUND - METALS, INORGANICS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers	Location Sample ID	Sample Date	Unit	MW-118	MW-137	MW-138	MW-138	MW-139	MW-140	MW-141	MW-142	MW-143	MW-144	MW-145	MW-146
Arsenic	0.05	MW-40	2/25/00	MG/L	0.019	0.023	0.14	0.13	0.051	0.022	0.13	1.3	0.087	0.51	0.014	0.087
Barium	2	MW-40	2/25/00	MG/L	0.73	0.39	0.6	0.28	0.4	0.59	0.06	1.4	0.05	0.12	0.67	0.31
Cadmium	0.005	MW-40	2/25/00	MG/L	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.004 U	0.007	0.004 U	0.004 U	0.004 U	0.004 U
Chromium III	0.1	MW-40	2/25/00	MG/L	0.01	0.005 U	0.007	0.008	0.007	0.007	0.032	0.021	0.052	0.019	0.009	0.007
Lead	0.005	MW-40	2/25/00	MG/L	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.06	0.008	0.073	0.031	0.005 U	0.005 U
Mercury	0.002	MW-40	2/25/00	MG/L	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0005 U	0.0009	0.0008	0.0005	0.0005 U	0.0006	0.0007
Selenium	0.05	MW-40	2/25/00	MG/L	0.032	0.036	0.022	0.023	0.038	0.036	0.041	0.03	0.033	0.034	0.046	0.026
Alkalinity		MW-40	2/25/00	MG/L	170	270	730	740	300	210	1200	900	1600	1100	550	220
Chloride	250	MW-40	2/25/00	MG/L	67	58	140	140	140	280	95	87	110	140	98	77
Fluoride	2	MW-40	2/25/00	MG/L	0.72	0.76	1.8	1.8	0.4	0.15	2.6	0.28	2.7	1.1	0.38	0.42
Nitrogen NH3-N		MW-40	2/25/00	MG/L	0.3	0.5	180	160	1.5	2.5	140	100	170	87	13	12
Nitrogen NO2-N	1	MW-40	2/25/00	MG/L	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nitrogen NO3-N	10	MW-40	2/25/00	MG/L	0.1	0.1	0.1 U	0.1 U	0.1 U	0.1	0.1 U	0.1	0.1 U	0.1 U	0.1 U	0.3
Sulfate	500	MW-40	2/25/00	MG/L	22	240	190	370	140	150	340	36	440	120	210	110
Total Dissolved Solids		MW-40	2/25/00	MG/L	350	790	830	1,000	1,040	1,010	1,500	980	2,000	1,500	990	460
Total Organic Carbon		MW-40	2/25/00	MG/L	57	50	45	43	41	42	140	92	220	100	23	26
Total Suspended Solids		MW-40	2/25/00	MG/L	73	704	41	36	360	14	33	330	54	110	24	301
TPH Diesel		MW-40	2/25/00	MG/L	18	3	1.5	1.9	3.5	3.9	3.5	2.2	30	2.2	0.61	1.1
TPH Diesel		MW-40	2/25/00	MG/L												
TPH/GRO		MW-40	2/25/00	MG/L	0.17	0.2	0.1 U	0.1 U	0.1 U	0.1 U	0.15	0.1 U	0.11	0.1 U	0.1 U	0.1 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

MG/L = milligram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

TABLE 5D

SUMMARY WATER SAMPLE ANALYTICAL RESULTS - SOIL PORE WATER - METALS

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Non Residential Used Aquifers*	Location ID Sample ID Sample Date Unit	MW-113 4/27/2000	MW-114 4/27/2000	MW-115 4/27/2000	MW-116 4/27/2000	MW-117 4/27/2000	MW-121 4/27/2000
Arsenic	0.05 mg/l	0.007	0.005 U	0.005 U	0.005 U	0.015	0.044	0.005 U
Barium	2 mg/l	0.15	0.1	0.97	0.9	0.9	0.4	0.8
Cadmium	0.005 mg/l	0.004 U	0.004 U	0.006	0.013	0.007	0.007	0.004 U
Chromium III	0.1 mg/l	0.005 U	0.006	0.007	0.017	0.011	0.011	0.006
Lead	0.005 mg/l	0.2 U	0.2 U	0.2 U	0.008	0.2 U	0.2 U	0.2 U
Selenium	0.05 mg/l	0.19	0.19	0.19	0.2	0.25	0.15	0.15

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

*Used Aquifer = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

MG/L = milligram per liter

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

TABLE 6

**SUMMARY OF COMPOUNDS DETECTED IN SURFACE SOIL
ABOVE THE SOIL TO GROUNDWATER PATHWAY MSC**

**PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA**

Compound	No. Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Pesticides (ug/kg)						
Alpha-BHC	18	2	200	49,000	24,600	24,600
Beta-BHC	18	1	6,500	6,500	6,500	6,500

TABLE 7A

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Soil to GW NR, unsaturated Use	Location Sample ID Date	B-PH1 B-1 (0-2) 2/10/00	B-PH2 B-2 (0-2) 2/14/00	B-PH3 B-3 (0-2) 2/22/00	B-PH4 B-4 (0-2) 2/8/00	B-PH5 B-5 (0-2) 2/15/00	B-PH6 B-6 (0-2) 2/15/00	B-PH7 B-7 (0-2) 2/16/00	B-PH8 B-8 (0-2) 2/7/00	B-PH9 B-9 (0-2) 2/12/00	B-PH10 B-10 (0-2) 2/8/00	B-PH11 B-11 (0-2) 2/22/00	B-PH12 MW-7 (0-2) 2/11/00
	NR, 0-2 ft	Aquifers*	Unit												
1,1,2,2-Tetrachloroethane	28,000	30	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
1,1,2-Trichloroethane	100,000	500	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
1,2-Dichloroethane	63,000	500	UG/KG	8 U	7	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
1,2-Dichloropropane	160,000	500	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
Acetone	10,000,000	1,000,000	UG/KG	240	100	510 D	78	1200 U	120	170	68	800 D	29	61	83
Benzene	210,000	500	UG/KG	24	24	89	18	230 U	49	37	28	250	5	3 U	29
Bromomethane	270,000	1,000	UG/KG	16 U	12 U	17 U	37 U	1200 U	12 U	5 J	14 U	20 U	13 U	13 U	22 U
Carbon disulfide	10,000,000	410,000	UG/KG	11 J	53	5 J	37 U	1200 U	23	10 J	6 J	17 J	13 U	13 U	7 J
Carbon tetrachloride	110,000	500	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
Chloromethane	920,000	300	UG/KG	16 U	12 U	17 U	37 U	1200 U	12 U	19 U	14 U	20 U	13 U	13 U	22 U
Dichloromethane	3,500,000	500	UG/KG	5 JB	240 B	160 B	7 JB	260 JB	81 B	32 B	3 JB	200 B	7 U	14 B	11 U
Ethylbenzene	10,000,000	70,000	UG/KG	8 U	6	9 U	19 U	590 U	8	23	7 U	13	7 U	6 U	11 U
Isopropyl Benzene	10,000,000	1,600,000	UG/KG	8 U	13	9 U	19 U	590 U	3 J	30	7 U	7 J	7 U	6 U	11 U
Methyl ethyl ketone	10,000,000	580,000	UG/KG	130	12 U	160	37 U	1200 U	33	32	19	350	10 J	9 J	31
Methyl tertiary butyl ether	3,200,000	2,000	UG/KG	8 U	6	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
o-Xylene			UG/KG	5 J	6 U	30	19 U	590 U	9	5 U	4 J	6 J	7 U	6 U	11 U
Tetrachloroethylene	1,500,000	500	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
Toluene	10,000,000	100,000	UG/KG	19	12	150	14 J	260 J	8	36	22	4 J	7 U	6 U	24
Trichloroethylene	970,000	500	UG/KG	8 U	6 U	9 U	19 U	590 U	6 U	9 U	7 U	10 U	7 U	6 U	11 U
Xylenes(Total)	10,000,000	1,000,000	UG/KG	12	12	66	19 U	590 U	16	42	12	10 U	7 U	6 U	17

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non-residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

TABLE 7A

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	MSC Soil to GW NR, 0-2 ft	MSC Use	Location Sample ID Sample Date	Unit	MW-137 MW-3 (0-2) 2/9/00	MW-137 Dup 2/9/00 2/9/00	MW-138 MW-4 (0-2) 2/14/00	MW-138 Dup 2/14/00 2/14/00	MW-145 MW-5 (0-2) 2/11/00	MW-139 MW-6 (0-2) 2/10/00	MW-146 MW-10 (0-2) 2/22/00	MW-146 Dup 2/22/00 2/22/00
1,2-Dichloroethane	63,000	500	UG/KG			8 U	8 U	9 U	10 U	5 J	11 U	6 U	6 U
Acetone	10,000,000	1,000,000	UG/KG			19	25	47	69	37	150	74	110
Benzene	210,000	500	UG/KG			3 U	3 U	270	90	25	49	3 U	3 U
Carbon disulfide	10,000,000	410,000	UG/KG			16 U	16 U	18 U	21 U	4 J	5 J	13 U	13 U
Chlorobenzene	10,000,000	10,000	UG/KG			8 U	8 U	9 U	10 U	13	74	6 U	6 U
Chloroform	17,000	10,000	UG/KG			8 U	8 U	9 U	10 U	4 J	11 U	6 U	6 U
Dichloromethane	3,500,000	500	UG/KG			8 U	8 U	120 B	150 B	180 B	12 B	12 B	44 B
Ethylbenzene	10,000,000	70,000	UG/KG			8 U	8 U	11	13	3 J	97	6 U	6 U
Isopropyl Benzene	10,000,000	37,000	UG/KG			8 U	8 U	9 U	10 U	7 U	160	6 U	6 U
Methyl ethyl ketone	10,000,000	580,000	UG/KG			16 U	5 J	15 J	21 U	12 J	34	12 J	25
o-Xylene	-	-	UG/KG			8 U	8 U	14	58	7 U	140	6 U	6 U
Toluene	10,000,000	100,000	UG/KG			8 U	8 U	44	130	8	28	6 U	4 J
Xylenes(Total)	10,000,000	1,000,000	UG/KG			8 U	8 U	34	91	5 J	170	6 U	6 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

TABLE 7B

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Soil to GW NR, unsaturated Use	Location Sample ID Sample Date	B-PH1 B-1 (0-2) 2/10/00	B-PH2 B-2 (0-2) 2/14/00	B-PH3 B-3 (0-2) 2/22/00	B-PH4 B-4 (0-2) 2/8/00	B-PH5 B-5 (0-2) 2/15/00	B-PH6 B-6 (0-2) 2/15/00	B-PH7 B-7 (0-2) 2/16/00	B-PH7 Dup 2/16/00	B-PH8 B-8 (0-2) 2/7/00	B-PH9 B-9 (0-2) 2/12/00	B-PH10 B-10 (0-2) 2/8/00	B-PH11 B-11 (0-2) 2/22/00	B-PH12 MW-7 (0-2) 2/11/00
		Aquifers*	Unit													
1,2,4-Trichlorobenzene	10,000,000	27,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
1,2-Dichlorobenzene	10,000,000	60,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
1,3-Dichlorobenzene	10,000,000	61,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
1,4-Dichlorobenzene	3,300,000	10,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2,4,6-Trichlorophenol	840,000	8,900	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2,4-Dichlorophenol	8,400,000	2,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2,4-Dinitrophenol	5,600,000	4,100	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
2,4-Dinitrotoluene	260,000	840	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2,6-Dinitrotoluene	2,800,000	10,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2-Chlorophenol	920,000	4,400	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
2-Nitroaniline	160,000	580	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
3,3'-Dichlorobenzidine	180,000	33,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
3-Nitroaniline	160,000	580	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
4-Chloroaniline	11,000,000	51,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
4-Nitroaniline	160,000	580	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
4-Nitrophenol	22,000,000	6,000	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
Aniline	53,000	580	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Anthracene	190,000,000	350,000	UG/KG	3900 U	4400 J	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Benzo(a)pyrene	11,000	46,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Benzo(a)anthracene	110,000	320,000	UG/KG	3900 U	6500 J	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Benzo(g,h,i)perylene	170,000,000	180,000	UG/KG	3900 U	40000 U	86000 U	370 J	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Bis(2-chloroethyl)ether	5,000	55	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Bis(2-chloroisopropyl) ether	160,000	30,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Hexachlorobenzene	50,000	960	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Hexachlorobutadiene	560,000	1,200	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Hexachlorocyclopentadiene	10,000,000	91,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Hexachloroethane	2,800,000	560	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Indeno(1,2,3-cd)pyrene	110,000	28,000,000	UG/KG	3900 U	40000 U	86000 U	280 J	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Isophorone	10,000,000	10,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
n-Nitroso-di-propylamine	11,000	37	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
n-Nitrosodiphenylamine	16,000,000	83,000	UG/KG	3900 U	4400 J	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Naphthalene	56,000,000	25,000	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Nitrobenzene	1,400,000	5,100	UG/KG	3900 U	40000 U	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Pentachlorophenol	660,000	5,000	UG/KG	9800 U	100000 U	210000 U	1500 U	48000 U	280000 U	48000 U	49000 U	23000 U	54000 U	23000 U	51000 U	5100 U
Phenanthrene	190,000,000	10,000,000	UG/KG	3900 U	40000 U	86000 U	270 J	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U
Pyrene	84,000,000	2,200,000	UG/KG	3900 U	6500 J	86000 U	620 U	19000 U	110000 U	19000 U	20000 U	9300 U	21000 U	9200 U	20000 U	2000 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

GW = groundwater

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Soil to GW NR, unsaturated Use	Location Sample ID Sample Date Unit	MW-140 MW-2 (0-2) 2/9/00	MW-137 MW-3 (0-2) 2/9/00	MW-137 Dup 2/9/00 2/9/00	MW-138 MW-4 (0-2) 2/14/00	MW-138 Dup 2/14/00 2/14/00	MW-145 MW-5 (0-2) 2/11/00	MW-139 MW-6 (0-2) 2/10/00	MW-146 MW-10 (0-2) 2/22/00	MW-146 Dup 2/22/00 2/22/00
2,4-Dichlorophenol	8,400,000	2,000	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
2,4-Dinitrophenol	5,600,000	4,100	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
2,4-Dinitrotoluene	260,000	840	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
2,6-Dinitrotoluene	2,800,000	10,000	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
2-Chlorophenol	920,000	4,400	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
2-Methylnaphthalene	10,000,000	8,000,000	UG/KG	1900 U	9300 U	2300	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
2-Nitroaniline	160,000	580	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
3-Nitroaniline	160,000	580	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
4-Nitroaniline	160,000	580	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
4-Nitrophenol	22,000,000	6,000	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
Aniline	53,000	580	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Benzo(a)pyrene	11,000	46,000	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Bis(2-chloroethyl)ether	5,000	55	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Bis(2-ethylhexyl) phthalate	5,700,000	130,000	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Chrysene	11,000,000	230,000	UG/KG	1900 U	9300 U	970 J	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Fluoranthene	110,000,000	3,200,000	UG/KG	1900 U	9300 U	580 J	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Hexachlorobenzene	50,000	960	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Hexachlorobutadiene	560,000	1,200	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Hexachloroethane	2,800,000	560	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Isophorone	10,000,000	10,000	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
n-Nitroso-di-propylamine	11,000	37	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Naphthalene	56,000,000	25,000	UG/KG	1900 U	9300 U	1500 J	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Nitrobenzene	1,400,000	5,100	UG/KG	1900 U	9300 U	1900 U	2100 U	11000 U	1900 U	2000 U	1900 U	1900 U
Pentachlorophenol	660,000	5,000	UG/KG	4700 U	23000 U	4800 U	5200 U	27000 U	4800 U	5000 U	4800 U	4900 U
Phenanthrene	190,000,000	10,000,000	UG/KG	1900 U	6900 J	2900	2100 U	18000	1900 U	2000 U	1900 U	1900 U
Pyrene	84,000,000	2,200,000	UG/KG	1900 U	5000 J	2600	2100 U	11000 U	1900 U	1700 J	1900 U	1900 U

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non-residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

GW = groundwater

TABLE 7C

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	MSC Soil to GW NR, unsaturated Use	Location Sample ID Sample Date Unit	B-PH1 B-1 (0-2) 2/10/00	B-PH2 B-2 (0-2) 2/14/00	B-PH3 B-3 (0-2) 2/22/00	B-PH4 B-4 (0-2) 2/8/00	B-PH5 B-5 (0-2) 2/15/00	B-PH6 B-6 (0-2) 2/15/00	B-PH7 B-7 (0-2) 2/16/00	B-PH7 Dup 2/16/00 2/16/00	B-PH8 B-8 (0-2) 2/7/00	B-PH9 B-9 (0-2) 2/12/00	B-PH10 B-10 (0-2) 2/8/00	B-PH11 B-11 (0-2) 2/22/00	B-PH12 MW-7 (0-2) 2/11/00
4,4'-DDDD	330,000	30,000	UG/KG	100	910 D	43 U	1 U	8 U	9 U	77	47	95	140	14	5.4	58
4,4'-DDE	230,000	170,000	UG/KG	8 U	130	43 U	1 U	8 U	9 U	7.3	4.7	13	43 U	4 U	4 U	5.7
4,4'-DDT	230,000	330,000	UG/KG	16 U	1100 D	86 U	2 U	16 U	18 U	37	25	44	86 U	26	8 U	55
alpha-BHC	13,000	190	UG/KG	4 U	200	21 U	1 U	4 U	4 U	2 U	2 U	4 U	21 U	2 U	2 U	2 U
beta-BHC	44,000	820	UG/KG	4 U	94	21 U	1 U	4 U	4 U	2 U	2 U	4 U	21 U	2 U	2 U	2 U
delta-BHC	1,700,000	30,000	UG/KG	4 U	33	21 U	1 U	4 U	4 U	2 U	2 U	4 U	21 U	2 U	2 U	2 U
gamma-Chlordane	-	-	UG/KG	16 U	8 U	86 U	2.8	16 U	18 U	8 U	8 U	15 U	86 U	7 U	8 U	8 U
Aroclor-1260	130,000	500,000	UG/KG	62	61 U	640 U	19 U	45	130 U	57 U	59 U	130	64 U	20	12 U	33

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

Exceeds MSC

TABLE 7C

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	MSC Soil to GW NR, unsaturated Use Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (0-2) 2/9/00	MW-137 MW-3 (0-2) 2/9/00	MW-137 Dup 2/9/00 2/9/00	MW-138 MW-4 (0-2) 2/14/00	MW-138 Dup 2/14/00 2/14/00	MW-145 MW-5 (0-2) 2/11/00	MW-139 MW-6 (0-2) 2/10/00	MW-146 MW-10 (0-2) 2/22/00	MW-146 Dup 2/22/00 2/22/00
4,4'-DDD	330,000	30,000	UG/KG	25	73	63	5	14	23000	14	80 D	49
4,4'-DDE	230,000	170,000	UG/KG	4 U	6.4	15	4 U	9 U	1900 U	4 U	10	14
4,4'-DDT	230,000	330,000	UG/KG	18	7 U	18	8 U	18 U	42000	8 U	110 D	67 D
Aldrin	4,700	440	UG/KG	2 U	2 U	4 U	2 U	4 U	960 U	2 U	0.4 U	0.4 U
alpha-BHC	13,000	190	UG/KG	2 U	6.8	4 U	2 U	4 U	49000	2 U	2.3	8.6
beta-BHC	44,000	820	UG/KG	2 U	2 U	4 U	2 U	4 U	6500	2 U	6.1	170 D
delta-BHC	840,000	30,000	UG/KG	2 U	2 U	4 U	2 U	4 U	960 U	2 U	0.4 U	2
Dieldrin	5,000	440	UG/KG	4 U	4 U	8 U	4 U	9 U	1900 U	4 U	1 U	1 U
gamma-BHC	72,000	72	UG/KG	2 U	2 U	4 U	2 U	4 U	960 U	2 U	0.4 U	0.4 U
Heptachlor	18,000	680	UG/KG	2 U	2 U	4 U	2 U	4 U	960 U	2 U	0.4 U	0.4 U
Heptachlor epoxide	8,700	1,100	UG/KG	2 U	2 U	4 U	2 U	4 U	960 U	2 U	0.4 U	1.8
Toxaphene	72,000	1,200	UG/KG	47 U	46 U	97 U	52 U	110 U	24000 U	50 U	10 U	10 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

PEST = pesticides

GW = groundwater

= exceeds MSC

TABLE 7D

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Soil to GW	Location	Sample ID	Sample Date	Unit	B-PH1	B-PH2	B-PH3	B-PH4	B-PH5	B-PH6	B-PH7	B-PH7 Dup 2/16/00	B-PH8	B-PH9	B-PH10	B-PH11	B-PH12
	NR, 0-2 ft.	NR, unsaturated	NR, 0-2 ft. Aquifers*	2/10/00	2/14/00	2/22/00	2/8/00	2/15/00	2/15/00	2/16/00	2/16/00	2/16/00	2/16/00	2/16/00	2/7/00	2/12/00	2/8/00	2/22/00	MW-7 (0-2) 2/11/00
Arsenic	53	150	MG/KG	2.8	8.3	0.9	0.2 U	2.1	0.2 U	4.8	2.5	0.2 U	4.8	2.5	8.1	1.9	2	14	2.9
Barium	190,000	8,200	MG/KG	68	84	76	260	230	150	120	66	150	120	66	96	90	140	180	120
Beryllium	5,600	320	MG/KG	0.5	0.8	1	0.6	0.8	1	0.9	0.6	1	0.9	0.6	0.8	2.3	0.6	0.9	0.8
Cadmium	210	38	MG/KG	1.9	2.8	2.1	3.2	2.7	2.7	3.3	2.2	2.7	3.3	2.2	2.5	2.5	5	3.4	4.3
Chromium	190,000	190,000	MG/KG	31	40	69	370	67	29	68	32	29	68	32	45	31	72	160	71
Copper	100,000	36,000	MG/KG	40	52	180	200	270	28	98	37	28	98	37	58	160	65	200	85
Lead	1,000	450	MG/KG	67	250	54	150	46	35	240	66	35	240	66	140	120	150	74	180
Mercury	840	10	MG/KG	1.1	0.97	4.3	0.0005 U	2.5	0.9	1.5	1.6	0.9	1.5	1.6	0.5	0.86	0.6	0.76	0.71
Nickel	56,000	650	MG/KG	12	20	27	54	20	16	18	14	16	18	14	17	16	32	28	18
Selenium	14,000	26	MG/KG	5.7	0.005 U	1.9	0.005 U	0.005 U	0.005 U	0.005 U	1.7	0.005 U	0.005 U	1.7	0.005 U	0.005 U	4.6	2.7	0.005 U
Silver	190,000	84	MG/KG	260	94	280	3.9	230	64	200	100	64	200	100	190	760	250	320	180
Cyanide Total	56,000	200	MG/KG	0.25 U	0.25 U	U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.3	0.25 U	0.25 U
TPH Diesel			MG/KG	10000	7500	20000	790	4300	58000	3600	4900				3500		2500	990	
TPH/GRO			MG/KG	0.43	63	0.1 U	0.2 U	22	10	2.5	0.8				0.14	2.8	0.37	0.1 U	0.36
Water by Evaporation			%	15.2	17.4	22.4	46	14	25.5	13	14.9				10.2	22.4	9.5	18.4	18.6

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

TABLE 7D

SUMMARY OF SURFACE SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - HPHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Soil to GW NR, 0-2 ft	Location Sample ID Sample Date	MW-140 MW-2 (0-2) 2/9/00	MW-137 MW-3 (0-2) 2/9/00	MW-137 Dup 2/9/00	MW-138 MW-4 (0-2) 2/14/00	MW-138 Dup 2/14/00	MW-145 MW-5 (0-2) 2/11/00	MW-139 MW-6 (0-2) 2/10/00	MW-146 MW-10 (0-2) 2/22/00	MW-146 Dup 2/22/00
Arsenic	190,000	53	150 MG/KG	0.2 U	0.4	12	1.9	1.8	21	0.2 U	1.3	16
Barium	5,600		8,200 MG/KG	27	22	140	62	65	86	89	68	99
Beryllium	210		320 MG/KG	0.004 U	0.004 U	1.3	1	1	0.7	0.5	1.1	1
Cadmium	190,000		38 MG/KG	1.9	0.9	2.6	2.5	2.3	3.2	1.4	2.5	2.7
Chromium	100,000		190,000 MG/KG	69	12	46	27	30	43	23	27	35
Copper	1,000		36,000 MG/KG	71	11	87	17	20	71	45	21	46
Lead	840		450 MG/KG	5.2	18	140	14	25	140	19	22	94
Mercury	56,000		10 MG/KG	0.3	1	0.7	0.64	0.55	2.5	2.8	0.27	0.83
Nickel	14,000		650 MG/KG	45	5	20	13	15	16	12	14	16
Selenium	190,000		26 MG/KG	8.8	0.005 U	0.4	0.005 U	1.2	10	1.1	0.005 U	0.005 U
Zinc			12,000 MG/KG	63	26	110	46	62	160	69	39	78
TPH Diesel			MG/KG	4900	7800	3400			6400	6200	230	180
TPH/GRO			MG/KG	0.1 U	5.3	0.1 U	8.3	27	0.47	3.3	0.1 U	0.1 U
Water by Evaporation			%	10.5	10.3	13.8	19.2	24	12.8	16.8	13.1	14.4

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2,500 ug/l

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

TABLE 8

**SUMMARY OF COMPOUNDS DETECTED IN
UNSATURATED SUBSURFACE SOIL
ABOVE THE SOIL TO GROUNDWATER PATHWAY MSC**

**PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA**

Compound	No. of Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Volatile Organic Compounds (ug/kg)						
Benzene	38	18	510	1,700,000	820,255	99,981
Dichloromethane*	38	12	540	67,000	33,770	6,511
Semi-volatile Organic Compounds (ug/kg)						
Naphthalene	38	2	68,000	79,000	73,500	73,500
Pesticides (ug/kg)						
4,4'-DDD	38	1	7,400	7,400	7,400	7,400
Metals (mg/kg)						
Arsenic	38	1	430	430	430	430

*- Dichloromethane (methylene chloride) is a common laboratory contaminant and was detected in the equipment blanks at concentrations up to 10 ug/l. These calculations are based on the detections in samples at concentrations greater than that in the blank.

TABLE 9A

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	Soil to GW NR, 2-15 ft	Soil to GW NR, unsaturated Used	Location Sample ID Sample Date	B-PH1 B-1 (8-10) 2/10/00	B-PH2 B-2 (10-12) 2/14/00	B-PH3 B-3 (6-8) 2/22/00	B-PH4 B-4 (13-15) 2/8/00	B-PH5 B-5 (11-13) 2/15/00	B-PH6 B-6 (13-15) 2/15/00	B-PH7 B-7 (13-15) 2/16/00	B-PH8 B-8 (7-9) 2/7/00	B-PH9 B-9 (8-10) 2/12/00	B-PH10 B-10 (7-9) 2/8/00	B-PH11 B-11 (6-8) 2/22/00	B-PH12 B-MW-7 (13-15) 2/11/00
1,1,2,2-Tetrachloroethane	28,000	100,000	33,000	30 UG/KG	580 U	6 U	6 U	840 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
1,1,2-Trichloroethane	100,000	120,000	120,000	500 UG/KG	580 U	6 U	6 U	840 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
1,1-Dichloroethylene	33,000	38,000	38,000	700 UG/KG	580 U	6 U	6 U	840 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
1,2-Dichloroethane	63,000	73,000	73,000	500 UG/KG	580 U	6 U	6 U	840 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
1,2-Dichloropropane	160,000	180,000	180,000	500 UG/KG	580 U	6 U	6 U	840 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
Acetone	10,000,000	10,000,000	10,000,000	1,000,000 UG/KG	1200 U	46	540 J	3300 U	3300 U	130	560 D	2000 U	1300 U	25	48	1000 J	200
Benzene	210,000	240,000	240,000	500 UG/KG	1600	5	6500	1200	1200	160	670 D	7800	260 U	6	8	2700	310 D
Bromomethane	270,000	300,000	300,000	1,000 UG/KG	1200 U	11 U	1700 U	3300 U	3300 U	10 U	15 U	2000 U	1300 U	16 U	14 U	2800 U	19 U
Carbon disulfide	10,000,000	10,000,000	10,000,000	410,000 UG/KG	1200 U	11 J	1700 U	3300 U	3300 U	26	150	2000 U	1300 U	11 J	3 J	2800 U	9 J
Carbon tetrachloride	110,000	120,000	120,000	500 UG/KG	580 U	6 U	840 U	1600 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
Chlorobenzene	10,000,000	10,000,000	10,000,000	10,000 UG/KG	580 U	30	840 U	1600 U	1600 U	5 U	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
cis-1,2-Dichloroethylene	920,000	1,000,000	1,000,000	300 UG/KG	1200 U	11 U	1700 U	3300 U	3300 U	10 U	15 U	2000 U	1300 U	16 U	14 U	2800 U	19 U
Dichloromethane	1,900,000	2,100,000	2,100,000	70,000 UG/KG	580 U	6 U	840 U	1600 U	1600 U	5 U	16	990 U	650 U	8 U	7 U	1400 U	10 U
Ethylbenzene	3,500,000	4,000,000	4,000,000	500 UG/KG	380 JB	170 B	470 JB	980 JB	980 JB	57 B	480 BD	1400 B	440 JB	310 B	7 U	1400 U	8 JB
Isopropyl Benzene	10,000,000	10,000,000	10,000,000	70,000 UG/KG	250 J	13	840 J	1600 U	1600 U	34	91	11000	650 U	5 J	3 J	39000	1500 D
Methyl ethyl ketone	10,000,000	10,000,000	10,000,000	1,600,000 UG/KG	580 U	9	840 U	1600 U	1600 U	4 J	8 U	3100	650 U	14	7 U	6900	390
Methyl tertiary butyl ether	3,200,000	3,700,000	3,700,000	580,000 UG/KG	580 U	6 U	840 U	1600 U	1600 U	5 U	8 U	2000 U	1300 U	7 J	16	2800 U	19 U
o-Xylene	-	-	-	2,000 UG/KG	230 J	5 J	1900	1900	1800	15	58	850 J	650 U	4 J	7 U	25000	1400 D
Tetrachloroethylene	1,500,000	3,300,000	3,300,000	500 UG/KG	580 U	6 U	840 U	1600 U	1600 U	5	8 U	990 U	650 U	8 U	7 U	1400 U	10 U
Toluene	10,000,000	10,000,000	10,000,000	100,000 UG/KG	580 U	7	960	1600 U	1600 U	28	110	390 J	310 J	6 J	7 U	1400 U	150
Trichloroethylene	970,000	1,100,000	1,100,000	500 UG/KG	580 U	6 U	840 U	1600 U	1600 U	5 U	11	990 U	650 U	8 U	7 U	1400 U	10 U
Vinyl chloride	53,000	220,000	220,000	200 UG/KG	1200 U	11 U	1700 U	3300 U	3300 U	10 U	15 U	2000 U	1300 U	16 U	14 U	2800 U	19 U
Xylenes (Total)	10,000,000	10,000,000	10,000,000	1,000,000 UG/KG	580 U	5 J	3500	3500	1900	20	180	18000	650 U	7 J	6 J	71000	620

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

J = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

= exceeds MSC

TABLE 9A

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	Soil to GW NR, unsaturated Used	Location Sample ID Sample Date	B-PH1 B-1 (17-19) 2/10/00	B-PH2 B-2 (22-24) 2/14/00	B-PH3 B-3 (9-11) 2/22/00	B-PH4 B-4 (18-20) 2/8/00	B-PH5 B-5 (22-24) 2/15/00	B-PH6 B-6 (23-25) 2/16/00	B-PH7 B-7 (41-43) 2/16/00	B-PH8 B-8 (24-26) 2/7/00	B-PH9 B-9 (13-15) 2/12/00	B-PH10 B-10 (22-24) 2/8/00	B-PH10 Dup 2/8/00 2/8/00	B-PH10 B-10 (28-30) 2/8/00	B-PH11 B-11 (10-12) 3/2/00	B-PH12 MW-7 (28-30) 2/11/00
1,1,1-Trichloroethane	10,000,000	10,000,000	NR, 2-15 R	20,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,1,2,2-Tetrachloroethane	28,000	33,000		30 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,1,2-Trichloroethane	100,000	120,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,1-Dichloroethane	1,000,000	1,200,000		11,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,1-Dichloroethylene	33,000	38,000		700 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,2-Dichloroethane	63,000	73,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
1,2-Dichloropropane	160,000	180,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
2-Hexanone				UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	21 U
4-Methyl-2-pentanone	4,300,000	4,900,000		41,000 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	21 U
Acetone	10,000,000	10,000,000		1,000,000 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	21 U
Benzene	210,000	240,000		500 UG/KG	610 U	1800 D	9100	650 U	10	5	410 U	1700000	2800 D	38000	23000	3500	14000	2200 D
Bromodichloromethane	45,000	51,000		10,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Bromomethane	270,000	300,000		1,000 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	21 U
Carbon disulfide	10,000,000	10,000,000		410,000 UG/KG	3000 U	110	1600 U	3300 U	13	93	2100 U	2700000 U	180	2100 U	2400 U	2300 U	2000 U	490 E
Carbon tetrachloride	110,000	120,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Chlorobenzene	10,000,000	10,000,000		10,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Chlorodibromomethane	61,000	70,000		10,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Chloroform	17,000	19,000		10,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Chloromethane	920,000	1,000,000		300 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	21 U
cis-1,2-Dichloroethylene	1,900,000	2,100,000		7,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	18
Dichloromethane	3,500,000	4,000,000		500 UG/KG	670 JB	130 B	590 JB	3300 B	140 B	110 B	660 JB	670000 JB	540 B	570 JB	650 JB	660 JB	1000 U	8 JB
Ethylbenzene	10,000,000	10,000,000		70,000 UG/KG	1500 U	5200 D	850	1600 U	6	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	2100	210
Isopropyl Benzene	10,000,000	10,000,000		1,600,000 UG/KG	1500 U	280	800 U	1600 U	29	360	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	2700	55
Methyl ethyl ketone	10,000,000	10,000,000		580,000 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	180	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	2000 U	410
Methyl tertiary butyl ether	320,000	3,700,000		2,000 UG/KG	1500 U	270	800 U	1600 U	3 J	25	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	2000 U	10 U
o-Xylene				UG/KG	1500 U	270	2500	1600 U	3 J	25	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	23000	140
Styrene	10,000,000	10,000,000		24,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Tetrachloroethylene	1,500,000	3,300,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Toluene	10,000,000	10,000,000		100,000 UG/KG	1500 U	68	940	850 J	5 U	9 J	2700	1300000 U	19 J	2700	1200 U	1200 U	1000 U	10 U
trans-1,2-Dichloroethylene	3,700,000	4,300,000		10,000 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	2100	140
Trichloroethylene	970,000	1,100,000		500 UG/KG	1500 U	6 U	800 U	1600 U	5 U	11 U	1000 U	1300000 U	21 U	1100 U	1200 U	1200 U	1000 U	10 U
Vinyl chloride	53,000	220,000		200 UG/KG	3000 U	13 U	1600 U	3300 U	9 U	23 U	2100 U	2700000 U	43 U	2100 U	2400 U	2300 U	2000 U	9 J
Xylenes (Total)	10,000,000	10,000,000		1,000,000 UG/KG	1100 J	180	3100	850 J	27	73	640 J	1300000 U	12 J	32000	1700	910 J	49000	320

Notes:
 MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations
 NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

= exceeds MSC

TABLE 9A

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	MSC Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Unit	MW-140 MW-2 (16-18) 2/9/00	MW-137 MW-3 (8-10) 2/9/00	MW-138 MW-4 (12-14) 2/14/00	MW-145 MW-5 (18-20) 2/11/00	MW-145 MW-5 (23-25) 2/11/00	MW-139 MW-6 (17-19) 2/10/00	MW-146 MW-10 (9-11) 2/22/00
1,1,2,2-Tetrachloroethane	28,000	33,000	30	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
1,1,2-Trichloroethane	1,000,000	120,000	500	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
1,1-Dichloroethylene	33,000	38,000	700	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
1,2-Dichloroethane	63,000	73,000	500	UG/KG	18 U	9 U	8 U	730 U	42	7 U	7 U
1,2-Dichloropropane	160,000	180,000	500	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
Acetone	10,000,000	10,000,000	1,000,000	UG/KG	100	100	210	1500 U	280	14 U	21
Benzene	210,000	240,000	500	UG/KG	7 U	180	9	19000	710 D	5	3 U
Bromomethane	270,000	300,000	1,000	UG/KG	36 U	18 U	8 J	1500 U	37 U	14 U	13 U
Carbon disulfide	10,000,000	10,000,000	410,000	UG/KG	46	8 J	28	1500 U	26 J	53	13 U
Carbon tetrachloride	110,000	120,000	500	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
Chlorobenzene	10,000,000	10,000,000	10,000	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
Chloroform	17,000	82,000	10,000	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	1 J
Chloromethane	920,000	1,000,000	300	UG/KG	36 U	18 U	16 U	1500 U	37 U	14 U	13 U
Dichloromethane	3,500,000	4,000,000	500	UG/KG	9 JB	5 JB	110 B	470 JB	1200 BD	7 U	62 B
Ethylbenzene	10,000,000	10,000,000	70,000	UG/KG	18 U	290	10	770	99	22	7 U
Isopropyl Benzene	10,000,000	10,000,000	1,600,000	UG/KG	18 U	50	100	730 U	19 U	26	7 U
Methyl ethyl ketone	10,000,000	10,000,000	580,000	UG/KG	19 J	35	16 U	1500 U	37 U	14 U	8 J
Methyl tertiary butyl ether	3,200,000	3,700,000	2,000	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
o-Xylene	-	-	-	UG/KG	18 U	340	79	730 U	91	4 J	7 U
Tetrachloroethylene	1,500,000	3,300,000	500	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
Toluene	10,000,000	10,000,000	100,000	UG/KG	18 U	94	14	440 J	140	7 J	7 U
Trichloroethylene	970,000	1,100,000	500	UG/KG	18 U	9 U	8 U	730 U	19 U	7 U	7 U
Vinyl chloride	53,000	220,000	200	UG/KG	36 U	18 U	16 U	1500 U	37 U	14 U	13 U
Xylenes(Total)	10,000,000	10,000,000	1,000,000	UG/KG	18 U	570	79	410 J	280	10	7 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

TABLE 9A

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	MSC Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (7-9) 2/9/00	MW-137 MW-3 (5-7) 2/9/00	MW-138 MW-4 (8-10) 2/14/00	MW-145 MW-5 (11-13) 2/11/00	MW-139 MW-6 (8-10) 2/10/00	MW-146 MW-10 (5-7) 2/22/00
Acetone	10,000,000	10,000,000	1,000,000	UG/KG	380	19	800 D	490 ID	29	23
Benzene	210,000	240,000	500	UG/KG	580	3 U	480 D	1200 D	4 U	2 U
Bromomethane	270,000	300,000	1,000	UG/KG	35 U	17 U	8 J	15 U	20 U	11 U
Carbon disulfide	10,000,000	10,000,000	410,000	UG/KG	32 J	17 U	330	120	20 U	11 U
Chloroethane	10,000,000	10,000,000	90,000	UG/KG	440	17 U	18 U	15 U	20 U	11 U
Chloroform	17,000	82,000	10,000	UG/KG	17 U	9 U	9 U	10	10 U	6 U
Dichloromethane	3,500,000	4,000,000	500	UG/KG	8 JB	9 U	240 B	570 ID	10 U	50 B
Ethylbenzene	10,000,000	10,000,000	70,000	UG/KG	55	9 U	240	130	10 U	6 U
Isopropyl Benzene	10,000,000	10,000,000	1,600,000	UG/KG	24	9 U	120	24	10 U	6 U
Methyl ethyl ketone	10,000,000	10,000,000	580,000	UG/KG	170	17 U	18 U	150	20 U	9 J
o-Xylene	-	-	-	UG/KG	57	9 U	500 D	190	10 U	6 U
Toluene	10,000,000	10,000,000	100,000	UG/KG	40	9 U	9 U	15	10 U	2 J
Xylenes(Total)	10,000,000	10,000,000	1,000,000	UG/KG	26	9 U	120	250	10 U	6 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

= exceeds MSC

TABLE 9A

SUMMARY OF UNSATURATED SUBSURFACE SAMPLE ANALYTICAL RESULTS - VOC's

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact NR, 0-2 ft	Soil to GW NR, 2-15 ft	Location Sample ID	GP-PH1 GP-1 (8') 2/7/00	GP-PH2 GP-2 Redrill (15) 2/16/00	GP-PH3 GP-3 (41') 2/11/00	GP-PH3 GP-3 Redrill (13.5) 2/16/00	GP-PH4 GP-4 (41') 2/11/00	GP-PH4 GP-4 Redrill (15) 2/16/00	GP-PH5 GP-5(12') 3/24/2000	GP-PH6 GP-6 (16') 2/7/00	GP-PH7 GP-7 (15') 2/7/00
	NR, 0-2 ft	NR, 2-15 ft	NR, 2-15 ft	Unit	unsaturated	unsaturated	unsaturated	unsaturated	unsaturated	unsaturated	unsaturated	unsaturated	unsaturated
1,1-Dichloroethane	1,000,000	1,200,000	11,000	UG/KG	5 U	12 U	11 U	9	520 U	590 U	5 U	660 U	590 U
2-Hexanone	10,000,000	10,000,000	1,000,000	UG/KG	10 U	23 U	22 U	14 U	1000 U	1200 U	11 U	1300 U	1200 U
Acetone	210,000	240,000	500	UG/KG	14	2200 D	1000 D	490 D	1100	21000	180	260 U	14000
Benzene	270,000	300,000	1,000	UG/KG	10 U	12 J	11 U	7 U	520 U	590 U	5 U	660 U	590 U
Bromoform	10,000,000	10,000,000	410,000	UG/KG	10	180	81	140	1000 U	1200 U	11 U	1300 U	1200 U
Bromomethane	10,000,000	10,000,000	10,000	UG/KG	63	12 U	11 U	7 U	520 U	590 U	5 U	660 U	590 U
Carbon disulfide	10,000,000	10,000,000	10,000	UG/KG	5 U	12 U	21	7 U	520 U	590 U	5 U	660 U	590 U
Chlorobenzene	17,000	82,000	10,000	UG/KG	5 U	12 U	520 JD	700 BD	420 JB	1100 B	3 J B	630 JB	340 JB
Chloroform	3,500,000	4,000,000	500	UG/KG	2 J	810 D	380	63	910	3800	61	660 U	1900
Dichloromethane	10,000,000	10,000,000	70,000	UG/KG	28	180	230	16	1000 U	1200 U	5 U	1300 U	1200 U
Ethylbenzene	10,000,000	10,000,000	1,600,000	UG/KG	10 U	23 U	11 U	7 U	520 U	590 U	19	660 U	590 U
Isopropyl Benzene	10,000,000	10,000,000	580,000	UG/KG	5 U	12 U	360 JD	150	520 U	590 U	5 U	660 U	590 U
Methyl ethyl ketone	3,200,000	3,700,000	2,000	UG/KG	5 U	12 U	11 U	15	520 U	590 U	16	500 J	280 J
Methyl tertiary butyl ether	1,500,000	3,300,000	500	UG/KG	2 J	45	66	99	2300	590 U	40	660 U	270 J
o-Xylene	10,000,000	10,000,000	100,000	UG/KG	3 J	130	620	99	2300	590 U	40	660 U	270 J
Tetrachloroethylene	10,000,000	10,000,000	1,000,000	UG/KG	3 J	130	620	99	2300	590 U	40	660 U	270 J
Toluene	10,000,000	10,000,000	1,000,000	UG/KG	3 J	130	620	99	2300	590 U	40	660 U	270 J
Xylenes(Total)	10,000,000	10,000,000	1,000,000	UG/KG	3 J	130	620	99	2300	590 U	40	660 U	270 J

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non-residential

*Use Aquifer = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = Groundwater

= exceeds MSC

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	MSC Soil to GW	Location Sample ID	B-PH1 B-1 (8-10) 2/10/00	B-PH2 B-2 (10-12) 2/14/00	B-PH3 B-3 (6-8) 2/22/00	B-PH4 B-4 (13-15) 2/8/00	B-PH5 B-5 (11-13) 2/15/00	B-PH6 B-6 (13-15) 2/15/00	B-PH7 B-7 (13-15) 2/16/00	B-PH8 B-8 (7-9) 2/7/00	B-PH9 B-9 (8-10) 2/12/00	B-PH10 B-10 (7-9) 2/8/00	B-PH11 B-11 (6-8) 2/22/00	B-PH12 MW-7 (13-15) 2/11/00
	NR, 0-2 ft	NR, 2-15 ft	Used	Unit												
1,2,4-Trichlorobenzene	10,000,000	10,000,000	27,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
1,2-Dichlorobenzene	10,000,000	10,000,000	60,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
1,3-Dichlorobenzene	10,000,000	10,000,000	61,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
1,4-Dichlorobenzene	3,300,000	190,000,000	10,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2,4,6-Trichlorophenol	8,400,000	190,000,000	8,900	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2,4-Dichlorophenol	8,400,000	190,000,000	2,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2,4-Dinitrophenol	5,600,000	190,000,000	4,100	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
2,6-Dinitrotoluene	2,800,000	190,000,000	840	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2-Chlorophenol	920,000	1,100,000	4,400	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2-Methylnaphthalene	10,000,000	10,000,000	8,000,000	UG/KG	6100 J	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
2-Nitroaniline	160,000	190,000,000	580	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
3,3'-Dichlorobenzidine	180,000	190,000,000	32,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
3-Nitroaniline	160,000	190,000,000	580	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
4-Chloroaniline	11,000,000	190,000,000	580	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
4-Nitroaniline	160,000	190,000,000	580	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
4-Nitrophenol	22,000,000	190,000,000	6,000	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
Aniline	53,000	60,000	580	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Anthracene	190,000,000	190,000,000	350,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Benzo(a)pyrene	11,000	190,000,000	46,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Benzo(b)fluoranthene	110,000	190,000,000	170,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Benzo(k)fluoranthene	1,100,000	190,000,000	610,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Bis(2-chloroisopropyl) ether	5,000	5,700	55	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Fluoranthene	110,000,000	190,000,000	3,200,000	UG/KG	5700 J	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Hexachlorobenzene	50,000	190,000,000	960	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Hexachlorobutadiene	560,000	10,000,000	1,200	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Hexachlorocyclopentadiene	10,000,000	10,000,000	91,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Hexachloroethane	2,800,000	190,000,000	560	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Isophorone	10,000,000	10,000,000	10,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
n-Nitroso-di-propylamine	11,000	10,000,000	37	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
n-Nitrosodiphenylamine	16,000,000	190,000,000	83,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Naphthalene	56,000,000	190,000,000	25,000	UG/KG	4200 J	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Nitrobenzene	1,400,000	10,000,000	5,100	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	9600 U	9600 U	110000 U	20000 U
Pentachlorophenol	660,000	190,000,000	5,000	UG/KG	26000 U	53000 U	280000 U	110000 U	47000 U	65000 U	280000 U	26000 U	24000 U	24000 U	280000 U	50000 U
Phenanthrene	190,000,000	190,000,000	10,000,000	UG/KG	25000 U	21000 U	110000 U	43000 U	19000 U	28000 U	76000 J	10000 U	15000 U	9600 U	110000 U	20000 U
Pyrene	84,000,000	190,000,000	2,200,000	UG/KG	10000 U	21000 U	110000 U	43000 U	19000 U	26000 U	110000 U	10000 U	15000 U	9600 U	110000 U	20000 U

Notes:
 MSC = Pennsylvania Department of Environmental Protection
 Land Recycling Program Medium Specific Concentrations
 NR = Non residential
 * = total dissolved solids less than or equal to 2500 mg/L
 MSCs not established for every compound
 UG/KG = microgram per kilogram
 U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL
 B = analyte also found in blank
 D = diluted
 SVOCs = semivolatile organic compounds
 GW = groundwater
 = exceeds MSC

TABLE 9B

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	MSC Soil to GW NR, unsaturated Aquifers*	Location Sample ID Sample Date	Unit	B-PH1 B-1 (17-19) 2/10/00	B-PH2 B-2 (22-24) 2/14/00	B-PH3 B-3 (9-11) 2/22/00	B-PH4 B-4 (18-20) 2/8/00	B-PH5 B-5 (22-24) 2/15/00	B-PH6 B-6 (23-25) 2/16/00	B-PH7 B-7 (41-43) 2/16/00	B-PH8 B-8 (24-26) 2/7/00	B-PH9 B-9 (13-15) 2/12/00	B-PH10 B-10 (22-24) 2/8/00	B-PH10 Dup 2/8/00 2/8/00	B-PH10 B-10 (28-30) 2/8/00	B-PH11 B-11 (10-12) 3/2/00	B-PH12 MW-7 (28-30) 2/11/00
1,2,4-Trichlorobenzene	10,000,000	10,000,000	27,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
1,2-Dichlorobenzene	10,000,000	10,000,000	60,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
1,3-Dichlorobenzene	10,000,000	10,000,000	61,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
1,4-Dichlorobenzene	3,300,000	190,000,000	10,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2,4,6-Trichlorophenol	840,000	190,000,000	8,900 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2,4-Dichlorophenol	8,400,000	190,000,000	2,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2,4-Dinitrophenol	5,600,000	190,000,000	4,100 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
2,4-Dinitrotoluene	260,000	190,000,000	840 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2,6-Dinitrotoluene	2,800,000	190,000,000	10,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2-Chlorophenol	920,000	1,100,000	4,400 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2-Methylnaphthalene	10,000,000	10,000,000	8,000,000 UG/KG	9500	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
2-Nitroaniline	160,000	190,000,000	580 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
3,3'-Dichlorobenzidine	180,000	190,000,000	32,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
3-Nitroaniline	160,000	190,000,000	580 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
4-Chloroaniline	11,000,000	190,000,000	52,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
4-Nitroaniline	160,000	190,000,000	580 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
4-Nitrophenol	22,000,000	190,000,000	6,000 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
Aniline	53,000	60,000	580 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Anthracene	190,000,000	190,000,000	350,000 UG/KG	2700 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Benzo(a)pyrene	11,000	190,000,000	46,000 UG/KG	3100 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Benzo(b)fluoranthene	11,000	190,000,000	170,000 UG/KG	1800 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Benzo(k)fluoranthene	1,100,000	190,000,000	610,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Benzo(a)anthracene	110,000	190,000,000	320,000 UG/KG	2600 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Benzo(g,h,i)perylene	170,000,000	190,000,000	180,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Bis(2-chloroisopropyl) ether	5,000	5,700	55 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Bis(2-ethylhexyl) phthalate	160,000	190,000	30,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Chrysene	5,700,000	10,000,000	130,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Dibenz(a,h)anthracene	11,000	190,000,000	230,000 UG/KG	4600 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Fluoranthene	110,000,000	190,000,000	160,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Fluorene	110,000,000	190,000,000	3,200,000 UG/KG	2500 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Hexachlorobenzene	50,000	190,000,000	960 UG/KG	4000 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Hexachlorobutadiene	560,000	10,000,000	1,200 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Hexachlorocyclopentadiene	10,000,000	10,000,000	91,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Isophorone	2,800,000	190,000,000	560 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
n-Nitroso-di-propylamine	10,000,000	10,000,000	10,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
n-Nitrosodiphenylamine	11,000	10,000,000	37 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Naphthalene	16,000,000	190,000,000	83,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Phenanthrene	110,000,000	190,000,000	25,000 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Pentachlorophenol	1,400,000	10,000,000	5,100 UG/KG	5200 U	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
Pyrene	190,000,000	190,000,000	5,000 UG/KG	13000 U	2800000 U	290000 U	290000 U	290000 U	29000 U	51000 U	75000 U	68000 U	270000 U	6500 U	170000 U	780000 U	54000 U	290000 U	28000 U
	84,000,000	190,000,000	10,000,000 UG/KG	3300 J	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U
			2,200,000 UG/KG	6600	1100000 U	120000 U	120000 U	120000 U	12000 U	20000 U	30000 U	27000 U	110000 U	6500 U	66000 U	310000 U	22000 U	120000 U	11000 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

J = not detected about method detection limit (MDL)

= indicates an estimated value below MDL

= exceeds MSC

TABLE 9B

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (7-9) 2/9/00	MW-137 MW-3 (5-7) 2/9/00	MW-138 MW-4 (8-10) 2/14/00	MW-145 MW-5 (11-13) 2/11/00	MW-139 MW-6 (8-10) 2/10/00	MW-146 MW-10 (5-7) 2/22/00
1,4-Dichlorobenzene	3,300,000	190,000,000	10,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
2,4-Dichlorophenol	8,400,000	190,000,000	2,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
2,4-Dinitrophenol	5,600,000	190,000,000	4,100	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
2,4-Dinitrotoluene	260,000	190,000,000	840	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
2,6-Dinitrotoluene	2,800,000	190,000,000	10,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
2-Chlorophenol	920,000	1,100,000	4,400	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
2-Methylnaphthalene	10,000,000	10,000,000	8,000,000	UG/KG	14000 J	5400 J	18000 J	4300 U	2000 U	2000 U
2-Nitroaniline	160,000	190,000,000	580	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
3-Nitroaniline	160,000	190,000,000	580	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
4-Nitroaniline	160,000	190,000,000	580	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
4-Nitrophenol	22,000,000	190,000,000	6,000	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
Aniline	53,000	60,000	580	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Anthracene	190,000,000	190,000,000	350,000	UG/KG	20000 U	10000 U	24000 U	4300 U	800 J	2000 U
Benzo(a)pyrene	11,000	190,000,000	46,000	UG/KG	20000 U	10000 U	24000 U	4300 U	680 J	2000 U
Benzo(b)fluoranthene	110,000	190,000,000	170,000	UG/KG	20000 U	10000 U	24000 U	4300 U	780 J	2000 U
Benzo(g,h,i)perylene	170,000,000	190,000,000	180,000	UG/KG	20000 U	10000 U	24000 U	4300 U	680 J	2000 U
Bis(2-chloroethyl)ether	5,000	5,700	55	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Bis(2-ethylhexyl) phthalate	5,700,000	10,000,000	130,000	UG/KG	20000 U	10000 U	24000 U	4300 U	5000	2000 U
Chrysene	11,000,000	190,000,000	230,000	UG/KG	20000 U	10000 U	24000 U	4300 U	900 J	2000 U
Fluoranthene	110,000,000	190,000,000	3,200,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2500	2000 U
Hexachlorobenzene	50,000	190,000,000	960	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Hexachlorobutadiene	560,000	10,000,000	1,200	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Hexachloroethane	2,800,000	190,000,000	560	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Isophorone	10,000,000	10,000,000	10,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
n-Nitroso-di-propylamine	11,000	10,000,000	37	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Naphthalene	110,000,000	190,000,000	25,000	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Nitrobenzene	1,400,000	10,000,000	5,100	UG/KG	20000 U	10000 U	24000 U	4300 U	2000 U	2000 U
Pentachlorophenol	660,000	190,000,000	5,000	UG/KG	51000 U	25000 U	59000 U	11000 U	5000 U	5100 U
Phenanthrene	190,000,000	190,000,000	10,000,000	UG/KG	20000 U	7100 J	14000 J	4300 U	2300	2000 U
Pyrene	84,000,000	190,000,000	2,200,000	UG/KG	20000 U	4300 J	24000 U	4300 U	6300	2000 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

GW = groundwater

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	MSC Soil to GW Used Aquifers*	Location Sample ID Sample Date	MW-140 MW-2 (16-18) 2/9/00	MW-137 MW-3 (8-10) 2/9/00	MW-138 MW-4 (12-14) 2/14/00	MW-145 MW-5 (18-20) 2/11/00	MW-145 MW-5 (23-25) 2/11/00	MW-139 MW-6 (17-19) 2/10/00	MW-146 MW-10 (9-11) 2/22/00
1,2,4-Trichlorobenzene	10,000,000	10,000,000	27,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
1,2-Dichlorobenzene	10,000,000	10,000,000	60,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
1,3-Dichlorobenzene	10,000,000	10,000,000	61,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
1,4-Dichlorobenzene	3,300,000	190,000,000	10,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2,4,6-Trichlorophenol	840,000	190,000,000	8,900	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2,4-Dichlorophenol	8,400,000	190,000,000	2,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2,4-Dinitrophenol	5,600,000	190,000,000	4,100	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
2,4-Dinitrotoluene	260,000	190,000,000	840	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2,6-Dinitrotoluene	2,800,000	190,000,000	10,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2-Chlorophenol	920,000	1,100,000	4,400	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
2-Methylnaphthalene	10,000,000	10,000,000	8,000,000	UG/KG	480 U	4300 J	9300 U	42000 U	15000 U	2000 U	2100 U
2-Nitroaniline	160,000	190,000,000	580	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
3,3'-Dichlorobenzidine	180,000	190,000,000	32,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
3-Nitroaniline	160,000	190,000,000	580	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
4-Chloroaniline	11,000,000	190,000,000	52,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
4-Nitroaniline	160,000	190,000,000	580	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
4-Nitrophenol	22,000,000	190,000,000	6,000	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
Acenaphthene	170,000,000	190,000,000	4,700,000	UG/KG	480 U	4000 J	9300 U	20000 U	15000 U	2000 U	2100 U
Aniline	53,000	60,000	580	UG/KG	480 U	10000 J	9300 U	20000 U	15000 U	2000 U	2100 U
Anthracene	190,000,000	190,000,000	350,000	UG/KG	210 J	10000 J	9300 U	20000 U	15000 U	2000 U	2100 U
Benzo(a)pyrene	11,000	190,000,000	46,000	UG/KG	210 J	6500 J	9300 U	20000 U	15000 U	2000 U	2100 U
Benzo(b)fluoranthene	110,000	190,000,000	170,000	UG/KG	320 J	6300 J	9300 U	20000 U	15000 U	2000 U	2100 U
Benzo(k)fluoranthene	1,100,000	190,000,000	610,000	UG/KG	230 J	3900 J	9300 U	20000 U	15000 U	2000 U	2100 U
Benzo(a)anthracene	110,000	190,000,000	320,000	UG/KG	230 J	8400 J	9300 U	20000 U	15000 U	2000 U	2100 U
Benzo(g,h,i)perylene	170,000,000	190,000,000	180,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Bis(2-chloroethyl)ether	5,000	5,700	55	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Bis(2-chloroisopropyl) ether	160,000	190,000	30,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Bis(2-ethylhexyl) phthalate	5,700,000	10,000,000	130,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Chrysene	11,000,000	190,000,000	230,000	UG/KG	370 J	12000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Dibenz(a,h)anthracene	11,000	190,000,000	160,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Diethyl phthalate	10,000,000	10,000,000	500,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Fluoranthene	110,000,000	190,000,000	3,200,000	UG/KG	340 J	9700 J	9300 U	20000 U	15000 U	2000 U	2100 U
Fluorene	110,000,000	190,000,000	3,800,000	UG/KG	480 U	3900 J	9300 U	20000 U	15000 U	2000 U	2100 U
Hexachlorobenzene	50,000	190,000,000	960	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Hexachlorobutadiene	560,000	10,000,000	1,200	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Hexachlorocyclopentadiene	10,000,000	10,000,000	91,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Hexachloroethane	2,800,000	190,000,000	560	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Isophorone	10,000,000	10,000,000	10,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
n-Nitroso-di-propylamine	11,000	10,000,000	37	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
n-Nitrosodiphenylamine	16,000,000	190,000,000	83,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Naphthalene	110,000,000	190,000,000	25,000	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Nitrobenzene	1,400,000	10,000,000	5,100	UG/KG	480 U	10000 U	9300 U	20000 U	15000 U	2000 U	2100 U
Pentachlorophenol	660,000	190,000,000	5,000	UG/KG	1200 U	25000 U	23000 U	51000 U	39000 U	5100 U	5200 U
Phenanthrene	190,000,000	190,000,000	10,000,000	UG/KG	240 J	22000 U	9300 J	17000 J	15000 U	2000 U	2100 U
Pyrene	84,000,000	190,000,000	2,200,000	UG/KG	490	24000 U	9300 U	7500 J	15000 U	1300 J	2100 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

GW = groundwater

J = exceeds MSC

TABLE 9C

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	B-PH1 B-1 (8-10) 2/10/00	B-PH2 B-2 (10-12) 2/14/00	B-PH3 B-3 (6-8) 2/22/00	B-PH4 B-4 (13-15) 2/8/00	B-PH5 B-5 (11-13) 2/15/00	B-PH6 B-6 (13-15) 2/15/00	B-PH7 B-7 (13-15) 2/16/00	B-PH8 B-8 (7-9) 2/7/00	B-PH9 B-9 (8-10) 2/12/00	B-PH10 B-10 (7-9) 2/8/00	B-PH11 B-11 (6-8) 2/22/00	B-PH12 MW-7 (13-15) 2/11/00
4,4'-DDD	NR, 0-2 ft	NR, 2-15 ft	30,000	UG/KG	65	18	48	350	31	5 U	11	30	210	56	260	80 U
4,4'-DDE	330,000	190,000,000	170,000	UG/KG	17 U	9.5	18 U	85 U	4 U	5 U	5 U	16	44	9	31	80 U
4,4'-DDT	230,000	190,000,000	330,000	UG/KG	33 U	19	36 U	170 U	7 U	10 U	9 U	8 U	15 U	36	18 U	160 U
alpha-BHC	13,000	190,000,000	190	UG/KG	140	2 U	9 U	110	2 U	3 U	2 U	2 U	4 U	2 U	4 U	40 U
beta-BHC	44,000	190,000,000	820	UG/KG	59	2 U	9 U	100	2 U	3 U	2 U	2 U	4 U	2 U	4 U	40 U
Dieldrin	5,000	10,000,000	440	UG/KG	17 U	4 U	18 U	85 U	4 U	5 U	5 U	4 U	31	4 U	9 U	80 U
Endrin aldehyde	200,000	10,000,000	190,000	UG/KG	78	8 U	36 U	170 U	7 U	10 U	9 U	8 U	15 U	8 U	18 U	160 U
Aroclor-1016	130,000	190,000,000	500,000	UG/KG	250 U	64 U	530 U	1300 U	11 U	78 U	68 U	12 U	57 U	97	67 U	120 U
Aroclor-1260				UG/KG	250 U	64 U	530 U	1300 U	19	78 U	68 U	22	660	87	67 U	120 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

PCBs = Polychlorinated Biphenyl

GW = groundwater

exceeds MSC

TABLE 9C

SUMMARY OF UNSATURATED ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY -PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct MSC	Direct MSC	Soil to GW Used	Location Sample Date Unit	B-PH1 B-1 (17-19) 2/10/00	B-PH2 B-2 (22-24) 2/14/00	B-PH3 B-3 (9-11) 2/22/00	B-PH4 B-4 (18-20) 2/8/00	B-PH5 B-5 (22-24) 2/15/00	B-PH6 B-6 (23-25) 2/16/00	B-PH7 B-7 (41-43) 2/16/00	B-PH8 B-8 (24-26) 2/7/00	B-PH9 B-9 (13-15) 2/12/00	B-PH10 B-10 (22-24) 2/8/00	B-PH10 Dup 2/8/00 2/8/00	B-PH10 B-10 (28-30) 2/8/00	B-PH11 B-11 (10-12) 3/2/00	B-PH12 MW-7 (28-30) 2/11/00
4,4'-DDD	330,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	30,000 UG/KG	11000 D	60	68	94	6700 D	190	50	640 D	1700 D	1500 D	170	130	1400
4,4'-DDE	230,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	170,000 UG/KG	3300	22 U	46 U	4 U	690	680 D	9 U	210	140	74	4 U	30	96
4,4'-DDT	230,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	330,000 UG/KG	250	44 U	93 U	8 U	120 U	13	17 U	13 U	35 U	17 U	9 U	19 U	91 U
Aldrin	4,700	190,000,000	NR, 0-2 ft	NR, 2-15 ft	440 UG/KG	26 U	11 U	23 U	2 U	30 U	3 U	4 U	3 U	9 U	4 U	2 U	5 U	23 U
alpha-BHC	13,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	190 UG/KG	26 U	11 U	23 U	2 U	30 U	3 U	4 U	3 U	9 U	4 U	2 U	5 U	23 U
beta-BHC	44,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	820 UG/KG	26 U	11 U	23 U	2 U	30 U	3 U	4 U	3 U	9 U	4 U	2 U	5 U	23 U
delta-BHC	840,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	30,000 UG/KG	26 U	11 U	23 U	2 U	30 U	3 U	4 U	3 U	9 U	4 U	2 U	5 U	23 U
Dieldrin	5,000	10,000,000	NR, 0-2 ft	NR, 2-15 ft	440 UG/KG	52 U	22 U	46 U	4 U	60 U	5 U	9 U	6 U	18 U	8 U	4 U	9 U	45 U
gamma-BHC	61,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	72 UG/KG	26 U	11 U	23 U	2 U	30 U	3 U	4 U	3 U	9 U	4 U	2 U	5 U	23 U
Aroclor-1260	130,000	190,000,000	NR, 0-2 ft	NR, 2-15 ft	500,000 UG/KG	390 U	66 U	700 U	33	900 U	82 U	13 U	340	13 U	37 U	13 U	140 U	340 U

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

PCBs = Polychlorinated Biphenyl

= exceeds MSC

TABLE 9C

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	MSC Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (7-9) 2/9/00	MW-137 MW-3 (5-7) 2/9/00	MW-138 MW-4 (8-10) 2/14/00	MW-145 MW-5 (11-13) 2/11/00	MW-139 MW-6 (8-10) 2/10/00	MW-146 MW-10 (5-7) 2/22/00
4,4'-DDD	330,000	190,000,000	30,000	UG/KG	41 U	1800	41	17	25	130 D
4,4'-DDE	230,000	190,000,000	170,000	UG/KG	41 U	130	9 U	4 U	8 U	17
4,4'-DDT	230,000	190,000,000	330,000	UG/KG	81 U	250	19 U	17	16 U	18
alpha-BHC	13,000	190,000,000	190	UG/KG	20 U	940	5 U	8.9	6.1	3.8
beta-BHC	44,000	190,000,000	820	UG/KG	20 U	350	5 U	2 U	4 U	15
delta-BHC	840,000	190,000,000	30,000	UG/KG	20 U	79	5 U	2 U	4 U	4.6
Heptachlor epoxide	8,700	190,000,000	1,100	UG/KG	20 U	35	5 U	2 U	4 U	0.4 U

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

PCBs = Polychlorinated Biphenyl

= exceeds MSC

TABLE 9C

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (16-18) 2/9/00	MW-137 MW-3 (8-10) 2/9/00	MW-138 MW-4 (12-14) 2/14/00	MW-145 MW-5 (18-20) 2/11/00	MW-145 MW-5 (23-25) 2/11/00	MW-139 MW-6 (17-19) 2/10/00	MW-146 MW-10 (9-11) 2/22/00
4,4'-DDD	330,000	190,000,000	30,000	UG/KG	5 U	190	7400 D	41 U	320	31	4 U
4,4'-DDE	230,000	190,000,000	170,000	UG/KG	5 U	15	500 D	41 U	34	8 U	4 U
4,4'-DDT	230,000	190,000,000	330,000	UG/KG	10 U	8 U	83	81 U	49 U	16 U	8 U
alpha-BHC	13,000	190,000,000	190	UG/KG	2 U	8.9	4.2	20 U	12 U	4 U	2 U
beta-BHC	44,000	190,000,000	820	UG/KG	2 U	16	23	20 U	12 U	4 U	2 U
delta-BHC	840,000	190,000,000	30,000	UG/KG	2 U	7.8	36	20 U	12 U	4 U	2 U
gamma-BHC	72,000	190,000,000	72	UG/KG	2 U	2 U	2 U	20 U	12 U	4 U	2 U
Heptachlor epoxide	8,700	190,000,000	1,600	UG/KG	2 U	3.5	2 U	20 U	12 U	4 U	2 U
Aroclor-1260	130,000	190,000,000	500,000	UG/KG	21	61 U	170	61 U	140	12 U	62 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

PCBs = Polychlorinated Biphenyl

GW = groundwater

exceeds MSC

TABLE 9D

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	Direct Contact MSC	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	B-PH1 B-1 (8-10) 2/10/00	B-PH2 B-2 (10-12) 2/14/00	B-PH3 B-3 (6-8) 2/22/00	B-PH4 B-4 (13-15) 2/8/00	B-PH5 B-5 (11-13) 2/15/00	B-PH6 B-6 (13-15) 2/15/00	B-PH7 B-7 (13-15) 2/16/00	B-PH8 B-8 (7-9) 2/7/00	B-PH9 B-9 (8-10) 2/12/00	B-PH10 B-10 (7-9) 2/8/00	B-PH11 B-11 (6-8) 2/22/00	B-PH12 MW-7 (13-15) 2/11/00
Arsenic	53	190,000	NR, 2-15 ft.	150 MG/KG	13	0.9	1.3	0.2 U	8.5	0.2 U	5.2	0.2 U	4.1	0.2 U	22	0.8
Barium	190,000	190,000	8,200 MG/KG	MG/KG	70	82	99	38	70	30	59	64	100	220	400	45
Beryllium	5,600	190,000	320 MG/KG	MG/KG	0.9	0.7	0.5	0.6	0.8	0.7	0.7	0.6	0.8	0.9	0.7	1
Cadmium	210	190,000	38 MG/KG	MG/KG	2.9	2.1	1.4	1.7	2.6	1.5	2	2.1	2.4	4.1	7.2	3.7
Chromium	190,000	190,000	36,000 MG/KG	MG/KG	35	44	82	37	24	28	31	30	28	360	57	45
Copper	100,000	190,000	450 MG/KG	MG/KG	64	33	44	27	63	27	43	19	70	110	490	12
Lead	1,000	190,000	10 MG/KG	MG/KG	74	35	97	16	25	7	120	18	50	54	1000	16
Mercury	840	190,000	650 MG/KG	MG/KG	1	0.42	2.8	0.5	0.67	0.42	0.71	0.6	2.9	0.9	2	0.0005 U
Nickel	56,000	190,000	26 MG/KG	MG/KG	19	17	12	10	13	8	12	14	22	39	25	11
Selenium	14,000	190,000	84 MG/KG	MG/KG	0.005 U	0.005 U	2.9	0.005 U	1.1	2.5	1.8	2.1	0.9	0.005 U	0.5 U	0.005 U
Silver	14,000	190,000	12,000 MG/KG	MG/KG	110	110	96	49	56	32	78	65	170	230	4	0.005 U
Zinc	190,000	190,000		MG/KG	50000	1300	63000	340000	2000	130000	100000	12000		7900	640	70
TPH Diesel				MG/KG	22	7.2	57	170	1.6	20	710	16	19	23	0.1 U	260
TPH/GRO				%	19.2	21.4	25	22	10.8	36.2	26.1	19.8	12.8	13.2	25.5	16.4
Water by Evaporation																

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

=exceeds MSC

TABLE 9D

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	B-PH1 B-1 (17-19) 2/10/00	B-PH2 B-2 (22-24) 2/14/00	B-PH3 B-3 (9-11) 2/22/00	B-PH4 B-4 (18-20) 2/8/00	B-PH5 B-5 (22-24) 2/15/00	B-PH6 B-6 (23-25) 2/16/00	B-PH7 B-7 (41-43) 2/16/00	B-PH8 B-8 (24-26) 2/7/00	B-PH9 B-9 (13-15) 2/12/00	B-PH10 B-10 (22-24) 2/8/00	B-PH10 Dup 2/8/00 2/8/00	B-PH10 B-10 (28-30) 2/8/00	B-PH11 B-11 (10-12) 3/2/00	B-PH12 MW-7 (28-30) 2/11/00
Arsenic	53	190,000	150	MG/KG	110	12	2	28	0.9	39	190	6.6	17	0.7	2.6	3.8	8.3	3.2
Barium	190,000	190,000	8,200	MG/KG	250	60	100	120	62	160	240	53	120	54	81	50	410	87
Beryllium	5,600	190,000	320	MG/KG	0.9	0.7	0.9	0.6	0.8	0.5	1	0.5	0.4	1.1	0.5	0.9	0.9	2.8
Cadmium	210	190,000	38	MG/KG	9.7	2.4	2	2.1	2.3	2.8	7.5	1.8	3.3	1.4	1.6	2	7.1	2.6
Chromium	190,000	190,000	190,000	MG/KG	100	42	45	32	24	31	82	34	61	27	29	41	46	51
Copper	100,000	190,000	36,000	MG/KG	180	26	53	47	21	140	200	280	180	44	59	37	360	200
Lead	1,000	190,000	450	MG/KG	210	55	39	63	20	370	390	300	300	28	78	25	670	130
Mercury	840	190,000	10	MG/KG	3.3	1.1	3.5	0.0005 U	1.2	1.3	5.7	0.0005 U	1.9	0.3	0.4	0.0005 U	1.4	2.8
Nickel	56,000	190,000	650	MG/KG	22	20	42	20	14	11	22	17	40	9	13	14	19	43
Selenium	14,000	190,000	26	MG/KG	3.8	0.005 U	1.3	2.5	0.005 U	9.8	11	3.5	2.5	2.2	1.1	0.005 U	0.4 U	1
Silver	14,000	190,000	84	MG/KG	1.6	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	1.3	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	2.7	0.005 U
Zinc	190,000	190,000	12,000	MG/KG	620	58	87	140	49	230	800	120	160	230	93	61	410	1100
Cyanide Total	56,000	190,000	200	MG/KG	0.25 U	0.25 U	0.38	0.25 U	0.25 U	0.25 U	1.4	2.4	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
TPH Diesel				MG/KG	19000	84000	77000	15000	2700	23000	11000	95000		300000	210000	110000	25000	
TPH/GRO				MG/KG	790	82	150	37	180	92	600	410	80	310	330	15	0.1 U	31
Water by Evaporation				%	35.3	24.4	28.3	27.6	18.3	44.6	38.9	22.4	48.5	24.7	19.8	22.7	28	26.4

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non-residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

=exceeds MSC

TABLE 9D

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (7-9) 2/9/00	MW-137 MW-3 (5-7) 2/9/00	MW-138 MW-4 (8-10) 2/14/00	MW-145 MW-5 (11-13) 2/11/00	MW-139 MW-6 (17-19) 2/10/00	MW-146 MW-10 (5-7) 2/22/00
Arsenic	53	190,000	150	MG/KG	0.2 U	7.8	2.1	0.2 U	7.6	1
Barium	190,000	190,000	8,200	MG/KG	64	58	56	30	96	73
Beryllium	5,600	190,000	320	MG/KG	0.7	0.7	0.7	0.5	0.8	1.1
Cadmium	210	190,000	38	MG/KG	1.9	2.1	1.7	1	3.7	3
Chromium	190,000	190,000	190,000	MG/KG	24	30	28	14	28	28
Copper	100,000	190,000	36,000	MG/KG	29	42	21	9	95	30
Lead	1,000	190,000	450	MG/KG	22	160	33	5.6	200	29
Mercury	840	190,000	10	MG/KG	0.0005 U	0.3	0.35	0.37	1.4	0.3
Nickel	56,000	190,000	650	MG/KG	9	15	10	5	14	16
Selenium	14,000	190,000	26	MG/KG	0.005 U	0.005 U	2.2	8.5	0.005 U	0.005 U
Zinc	190,000	190,000	12,000	MG/KG	53	73	67	18	99	130
Cyanide Total	56,000	190,000	200	MG/KG	0.25 U	0.25 U	1.7	0.25 U	0.25 U	U
TPH Diesel				MG/KG	150000	13000		73000	2400	120
TPH/GRO				MG/KG	6.2	130	190	5.5	8.5	0.1 U
Water by Evaporation				%	17.7	17.4	29.5	23.1	17.8	18.5

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

= exceeds MSC

Sum of soil results
Unsat 2-15, Other
11/17/2004

TABLE 9D

SUMMARY OF UNSATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC NR, 0-2 ft	Direct Contact MSC NR, 2-15 ft	MSC Soil to GW NR, unsaturated Used Aquifers*	Location Sample ID Sample Date Unit	MW-140 MW-2 (16-18) 2/9/00	MW-137 MW-3 (8-10) 2/9/00	MW-138 MW-4 (12-14) 2/14/00	MW-145 MW-5 (18-20) 2/11/00	MW-145 MW-5 (23-25) 2/11/00	MW-139 MW-6 (17-19) 2/10/00	MW-146 MW-10 (9-11) 2/22/00
Arsenic	53	190,000	150	MG/KG	430	3.7	24	0.2 U	0.6	7.6	5.3
Barium	190,000	190,000	8,200	MG/KG	59	51	56	31	38	96	75
Beryllium	5,600	190,000	320	MG/KG	0.7	0.7	0.6	0.8	0.004 U	0.8	0.8
Cadmium	210	190,000	38	MG/KG	1.8	2.5	2.4	3.3	0.7	3.7	2.1
Chromium	190,000	190,000	190,000	MG/KG	46	34	35	57	29	28	20
Copper	100,000	190,000	36,000	MG/KG	26	29	53	6	47	95	53
Lead	1,000	190,000	450	MG/KG	37	55	37	10	34	200	71
Mercury	840	190,000	10	MG/KG	0.6	0.59	0.88	0.0005 U	0.61	1.4	1.1
Nickel	56,000	190,000	650	MG/KG	16	14	13	3	5	14	13
Selenium	14,000	190,000	26	MG/KG	0.005 U	0.005 U	4.2	0.005 U	2.3	0.005 U	0.005 U
Zinc	190,000	190,000	12,000	MG/KG	85	74	130	15	57	99	68
TPH Diesel				MG/KG	2300	13000		66000	24000	2400	390
TPH/GRO				MG/KG	3	15	85	240	43	8.5	0.2
Water by Evaporation				%	30.8	18	28	17.9	46	17.8	19.4

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

= exceeds MSC

TABLE 10

**SUMMARY OF COMPOUNDS DETECTED IN
SATURATED SUBSURFACE SOIL
ABOVE THE SOIL TO GROUNDWATER PATHWAY MSC**

**PHILLIPS ISLAND
SUNOCO, INC. REFINERY
MARCUS HOOK, PENNSYLVANIA**

Compound	No. Samples	No. Detections Above MSC	Minimum	Maximum	Median	Mean
Volatile Organic Compounds (ug/kg)						
Dichloromethane	15	2	720	1,900	1,310	1,310
Metals (mg/kg)						
Arsenic	15	5	16	1,700	858	438
Cadmium	15	1	7.3	7.3	7.3	7.3
Lead	15	3	61	580	320	364
Mercury	15	1	4	4	4	4
Selenium	15	1	6.7	6.7	6.7	6.7

TABLE 11A

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - VOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Soil to GW NR, saturated Use	Location Sample ID Sample Date	B-PH1 B-1 (21-23) 2/10/00	B-PH2 B-2 (37-39) 2/14/00	B-PH3 B-3 (14-16) 2/22/00	B-PH4 B-4 (23-25) 2/8/00	B-PH5 B-5 (24-26) 2/15/00	B-PH7 B-7 (48-50) 2/16/00	B-PH8 B-8 (48-50) 2/7/00	B-PH9 B-9 (23-25) 2/12/00	B-PH11 B-11 (22-24) 3/2/00
	Aquifers*	Unit									
1,1,1-Trichloroethane	20,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
1,1,2,2-Tetrachloroethane	30	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
1,1,2-Trichloroethane	500	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
1,1-Dichloroethane	11,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
1,1-Dichloroethylene	700	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
1,2-Dichloroethane	500	UG/KG	7U	5J	520 U	10 U	6U	6U	940 U	5U	850 U
1,2-Dichloropropane	500	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
2-Hexanone		UG/KG	15U	12U	1000 U	20 U	13U	13U	1900 U	11U	1700 U
4-Methyl-2-pentanone	41,000	UG/KG	15U	12U	1000 U	20 U	13U	13U	1900 U	11U	1700 U
Acetone	1,000,000	UG/KG	18	21	550 J	31	32	45	1900 U	33	1700 U
Benzene	500	UG/KG	3U	7	210 U	4	3U	3U	380 U	2U	340 U
Bromodichloromethane	10,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Bromomethane	1,000	UG/KG	15U	12U	1000 U	20 U	13U	13U	1900 U	11U	1700 U
Carbon disulfide	410,000	UG/KG	4J	3J	1000 U	20 U	7J	13U	1900 U	11U	1700 U
Carbon tetrachloride	500	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Chlorobenzene	10,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Chlorodibromomethane	10,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Chloroform	10,000	UG/KG	7U	4J	520 U	10 U	3J	6U	940 U	5U	850 U
Chloromethane	300	UG/KG	15U	12U	1000 U	20 U	13U	13U	1900 U	11U	1700 U
cis-1,2-Dichloroethylene	7,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Dichloromethane	500	UG/KG	4 JB	220 B	1900 B	4 JB	66 B	14 B	720 JB	5 JB	850 U
Ethylbenzene	70,000	UG/KG	7U	10	520 U	10 U	6U	6U	940 U	5U	850 U
Isopropyl Benzene	160,000	UG/KG	7U	3J	520 U	10 U	6U	6U	940 U	5U	580 J
Methyl ethyl ketone	580,000	UG/KG	15U	12U	460 J	20 U	9J	11J	1900 U	15	1700 U
Methyl tertiary butyl ether	2,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
o-Xylene		UG/KG	7U	7	520 U	10 U	6U	6U	940 U	5U	580 J
Styrene	10,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Tetrachloroethylene	500	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Toluene	100,000	UG/KG	3J	9	410 J	6J	6U	6U	1500	2J	850 U
trans-1,2-Dichloroethylene	10,000	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Trichloroethylene	500	UG/KG	7U	6U	520 U	10 U	6U	6U	940 U	5U	850 U
Vinyl chloride	200	UG/KG	15U	12U	1000 U	20 U	13U	13U	1900 U	11U	1700 U
Xylenes(Total)	1,000,000	UG/KG	7U	9	520 U	10 U	6U	6U	940 U	5U	1100

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

VOCs = volatile organic compounds

GW = groundwater

= exceeds MSC

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	MSC Soil to GW Use	Location Sample ID	Unit	B-PH1 B-1 (21-23) 2/10/00	B-PH2 B-2 (37-39) 2/14/00	B-PH3 B-3 (14-16) 2/22/00	B-PH4 B-4 (23-25) 2/8/00	B-PH5 B-5 (24-26) 2/15/00	B-PH7 B-7 (48-50) 2/16/00	B-PH8 B-8 (48-50) 2/7/00	B-PH9 B-9 (23-25) 2/12/00	B-PH11 B-11 (22-24) 3/2/00
1,2,4-Trichlorobenzene	7,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
1,2-Dichlorobenzene	60,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
1,3-Dichlorobenzene	60,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
1,4-Dichlorobenzene	7,500 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2,4,6-Trichlorophenol	3,100 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2,4-Dichlorophenol	2,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2,4-Dinitrophenol	4,100 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
2,4-Dinitrotoluene	840 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2,6-Dinitrotoluene	10,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2-Chlorophenol	4,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2-Methylnaphthalene	800,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
2-Nitroaniline	580 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
3,3'-Dichlorobenzidine	3,200 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
3-Nitroaniline	580 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
4-Chloroaniline	41,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
4-Nitroaniline	580 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
4-Nitrophenol	6,000 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
Aniline	580 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Anthracene	35,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Benzo(a)pyrene	4,600 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Benzo(b)fluoranthene	17,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Benzo(k)fluoranthene	61,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Benzo(a)anthracene	32,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Benzo(g,h,i)perylene	18,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Bis(2-chloroethyl)ether	55 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Bis(2-chloroisopropyl) ether	30,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Bis(2-ethylhexyl) phthalate	13,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Chrysene	23,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Dibenz(a,h)anthracene	16,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Fluoranthene	320,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Fluorene	380,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Hexachlorobenzene	100 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Hexachlorobutadiene	120 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Hexachlorocyclopentadiene	9,100 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Hexachloroethane	100 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Isophorone	10,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
n-Nitroso-di-propylamine	37 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
n-Nitrosodiphenylamine	53,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Naphthalene	10,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Nitrobenzene	5,100 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Pentachlorophenol	500 UG/KG	930 U	UG/KG	46000 U	990 U	46000 U	940 U	56000 U	1200 U	20000 U	930 U	65000 U
Phenanthrene	1,000,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U
Pyrene	220,000 UG/KG	370 U	UG/KG	18000 U	400 U	18000 U	380 U	22000 U	470 U	8000 U	370 U	26000 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

exceeds MSC

SVOCs = semivolatile organic compounds

GW = groundwater

D = diluted

B = analyte also found in blank

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - SVOCs
SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	MSC Soil to GW NR, saturated Use	Location Sample ID Sample Date	MW-140 MW-2 (23-25) 2/9/00	MW-137 MW-3 (18-20) 2/9/00	MW-138 MW-4 (23-25) 2/14/00	MW-145 MW-5 (48-50) 2/11/00	MW-139 MW-6 (23-25) 2/10/00	MW-146 MW-10(18-20) 2/22/00
1,2,4-Trichlorobenzene	7,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
1,2-Dichlorobenzene	60,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
1,3-Dichlorobenzene	60,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
1,4-Dichlorobenzene	7,500	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2,4,6-Trichlorophenol	3,100	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2,4-Dichlorophenol	2,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2,4-Dinitrophenol	4,100	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
2,4-Dinitrotoluene	840	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2,6-Dinitrotoluene	10,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2-Chlorophenol	4,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2-Methylnaphthalene	800,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
2-Nitroaniline	580	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
3,3'-Dichlorobenzidine	3,200	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
3-Nitroaniline	580	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
4-Chloroaniline	41,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
4-Nitroaniline	580	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
4-Nitrophenol	6,000	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
Acenaphthene	470,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Aniline	580	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Anthracene	35,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Benzo(a)pyrene	4,600	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Benzo(b)fluoranthene	17,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Benzo(k)fluoranthene	61,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Benzo(a)anthracene	32,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Benzo(g,h,i)perylene	18,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Bis(2-chloroethyl)ether	55	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Bis(2-chloroisopropyl) ether	30,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Bis(2-ethoxyhexyl) phthalate	13,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Chrysene	23,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Dibenz(a,h)anthracene	16,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Diethyl phthalate	500,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Fluoranthene	320,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Fluorene	380,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Hexachlorobenzene	100	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Hexachlorobutadiene	120	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Hexachlorocyclopentadiene	9,100	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Hexachloroethane	100	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Isophorone	10,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
n-Nitroso-di-propylamine	37	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
n-Nitrosodiphenylamine	53,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Naphthalene	10,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Nitrobenzene	5,100	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Pentachlorophenol	500	UG/KG	990 U	950 U	940 U	1200 U	960 U	7000 U
Phenanthrene	1,000,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U
Pyrene	220,000	UG/KG	400 U	380 U	370 U	460 U	380 U	2800 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
 Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

SVOCs = semivolatile organic compounds

GW = groundwater

J = exceeds MSC

TABLE 11C

SUMMARY OF SATURATED SOIL ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Soil to GW NR, saturated Use	Location Sample ID Sample Date Unit	B-PH1 B-1 (21-23) 2/10/00	B-PH2 B-2 (37-39) 2/14/00	B-PH3 B-3 (14-16) 2/22/00	B-PH4 B-4 (23-25) 2/8/00	B-PH5 B-5 (24-26) 2/15/00	B-PH7 B-7 (48-50) 2/16/00	B-PH8 B-8 (48-50) 2/7/00	B-PH9 B-9 (23-25) 2/12/00	B-PH11 B-11 (22-24) 3/2/00
4,4'-DDD	3,000	UG/KG	1 U	1 U	840	6.4	4 U	1 U	100	6.6	5 U
4,4'-DDE	17,000	UG/KG	1 U	1 U	59	1 U	4 U	1 U	100	2.3	5 U
4,4'-DDT	33,000	UG/KG	1 U	2 U	36 U	2 U	9 U	2 U	140	1 U	10 U
Aldrin	44	UG/KG	0.4 U	0.4 U	9 U	0.4 U	2 U	0.5 U	5 U	0.4 U	3 U
alpha-BHC	41	UG/KG	0.4 U	0.4 U	9 U	0.4 U	2 U	0.5 U	5 U	0.4 U	3 U
beta-BHC	140	UG/KG	0.4 U	0.4 U	9 U	0.4 U	2 U	0.5 U	5 U	0.4 U	3 U
delta-BHC	6,100	UG/KG	0.4 U	0.4 U	93	0.4 U	2 U	0.5 U	5 U	0.4 U	3 U
Dieldrin	44	UG/KG	1 U	1 U	18 U	1 U	4 U	1 U	11 U	1 U	5 U
gamma-BHC	20	UG/KG	0.4 U	0.4 U	9 U	0.4 U	2 U	0.5 U	5 U	0.4 U	3 U
Aroclor-1260	50,000	UG/KG	11 U	12 U	270 U	11 U	13 U	14 U	16 U	11 U	16 U

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected about method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

PCBs = Polychlorinated Biphenyl

= exceeds MSC

TABLE 11C

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - PESTICIDES AND PCBs

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Soil to GW NR, saturated Use	Location Sample ID Sample Date	MW-140 MW-2 (23-25) 2/9/00	MW-137 MW-3 (18-20) 2/9/00	MW-138 MW-4 (23-25) 2/14/00	MW-145 MW-5 (48-50) 2/11/00	MW-139 MW-6 (23-25) 2/10/00	MW-146 MW-10(18-20) 2/22/00
	Aquifers*	Unit						
4,4'-DDD	3,000	UG/KG	1 U	3.6	4.2	1 U	1 U	80 D
4,4'-DDE	17,000	UG/KG	1 U	1 U	1 U	1 U	1 U	11
4,4'-DDT	33,000	UG/KG	2 U	2 U	1 U	2 U	2 U	3
alpha-BHC	41	UG/KG	0.4 U	0.4 U	0.4 U	0.66	0.4 U	20
beta-BHC	140	UG/KG	0.4 U	0.4 U	0.4 U	0.5 U	0.4 U	19
delta-BHC	6,100	UG/KG	0.4 U	0.4 U	0.4 U	0.5 U	0.4 U	5.4
gamma-BHC	20	UG/KG	0.4 U	0.4 U	0.4 U	0.5 U	0.4 U	0.6 U
Heptachlor epoxide	100	UG/KG	0.4 U	0.4 U	0.4 U	0.5 U	0.4 U	0.6 U
Aroclor-1260	50,000	UG/KG	12 U	11 U	11 U	14 U	11 U	34 U

Notes:

MSC = Pennsylvania Department of Environmental Protection
Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

UG/KG = microgram per kilogram

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

PCBs = Polychlorinated Biphenyl

GW = groundwater

= exceeds MSC

TABLE 11D

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Soil to GW NR, saturated Use	Location Sample ID Sample Date	B-PH1 B-1 (21-23) 2/10/00	B-PH2 B-2 (37-39) 2/14/00	B-PH3 B-3 (14-16) 2/22/00	B-PH4 B-4 (23-25) 2/8/00	B-PH5 B-5 (24-26) 2/15/00	B-PH7 B-7 (48-50) 2/16/00	B-PH8 B-8 (48-50) 2/7/00	B-PH9 B-9 (23-25) 2/12/00	B-PH11 B-11 (22-24) 3/2/00
Arsenic	15	MG/KG	1.4	0.2 U	16	0.2 U	22	0.2 U	330	0.2 U	1700
Barium	820	MG/KG	20	73	28	31	53	57	500	44	200
Beryllium	32	MG/KG	0.3	0.9	0.4	0.5	0.8	1	1.2	0.8	1.2
Cadmium	3.8	MG/KG	0.8	2.2	2	2.5	1.7	1.4	7.3	1.2	3.3
Chromium	19,000	MG/KG	12	22	14	18	34	26	98	17	78
Copper	3,600	MG/KG	5	13	13	9	19	7	190	14	100
Lead	45	MG/KG	4.5	11	18	6.9	32	8.2	450	4.2	580
Mercury	1	MG/KG	0.0005 U	0.0005 U	0.28	0.0005 U	0.33	0.0005 U	0.3	0.0005 U	4
Nickel	65	MG/KG	8	20	7	8	14	15	27	17	25
Selenium	5	MG/KG	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	6.7	0.005 U	3.9
Silver	10	MG/KG	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.005 U	0.9	0.005 U	0.8 U
Zinc	1,200	MG/KG	19	45	55	30	68	78	740	47	360
Cyanide Total	20,000	MG/KG	0.25 U	0.25 U	U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U
TPH Diesel		MG/KG	23	100	5100	380	2800	35	4500		5200
TPH/GRO		MG/KG	0.39	0.1 U	19	0.23	32	0.59	490	0.1 U	0.2 U
Water by Evaporation		%	10.3	16.2	8.5	11.2	25.6	29.8	37.6	10.8	35.8

Notes:

MSC = Pennsylvania Department of Environmental Protection Land Recycling Program Medium Specific Concentrations

NR = Non-residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

B = analyte also found in blank

D = diluted

GW = groundwater

TABLE 11D

SUMMARY OF SATURATED SOIL SAMPLE ANALYTICAL RESULTS - METALS AND TPH

SUNOCO REFINERY - PHILLIPS ISLAND
MARCUS HOOK, PENNSYLVANIA

Parameter	Direct Contact MSC	MSC Soil to GW NR, saturated Use	Location Sample ID Sample Date	MW-140 MW-2 (23-25) 2/9/00	MW-137 MW-3 (18-20) 2/9/00	MW-138 MW-4 (23-25) 2/14/00	MW-145 MW-5 (48-50) 2/11/00	MW-139 MW-6 (23-25) 2/10/00	MW-146 MW-10(18-20) 2/22/00
	NR, 2-15 ft	Aquifers*	Unit						
Arsenic	190,000	15	MG/KG	0.2 U	0.2 U	0.2 U	4.2	0.2 U	120
Barium	190,000	820	MG/KG	71	180	25	68	21	68
Beryllium	190,000	32	MG/KG	0.9	0.5	0.6	1.3	0.004 U	0.8
Cadmium	190,000	3.8	MG/KG	2.1	2.2	1.5	2.4	1	1.8
Chromium	190,000	19,000	MG/KG	30	240	24	39	14	54
Copper	190,000	3,600	MG/KG	14	16	6	12	8	28
Lead	190,000	45	MG/KG	9	6.1	3.6	10	4	61
Mercury	190,000	1	MG/KG	0.3	0.0005 U	0.34	0.0005 U	0.0005 U	0.31
Nickel	190,000	65	MG/KG	24	10	9	22	10	15
Selenium	190,000	5	MG/KG	0.005 U	3.4	0.005 U	0.005 U	0.005 U	0.005 U
Zinc	190,000	1,200	MG/KG	58	28	25	66	23	160
TPH Diesel			MG/KG	130	45	0.2	32	6 U	610
TPH/GRO			MG/KG	0.1 U	0.28	0.2	0.1 U	0.1 U	0.2 U
Water by Evaporation			%	16.1	12.2	11.1	28.2	12.8	40.8

Notes:

MSC = Pennsylvania Department of Environmental Protection

Land Recycling Program Medium Specific Concentrations

NR = Non residential

* = total dissolved solids less than or equal to 2500 mg/L

MSCs not established for every compound

MG/KG = milligram per kilogram

TPH Diesel = total petroleum hydrocarbon-diesel range organics

TPH/GRO = total petroleum hydrocarbon-gasoline range organics

U = not detected above method detection limit (MDL)

J = indicates an estimated value below MDL

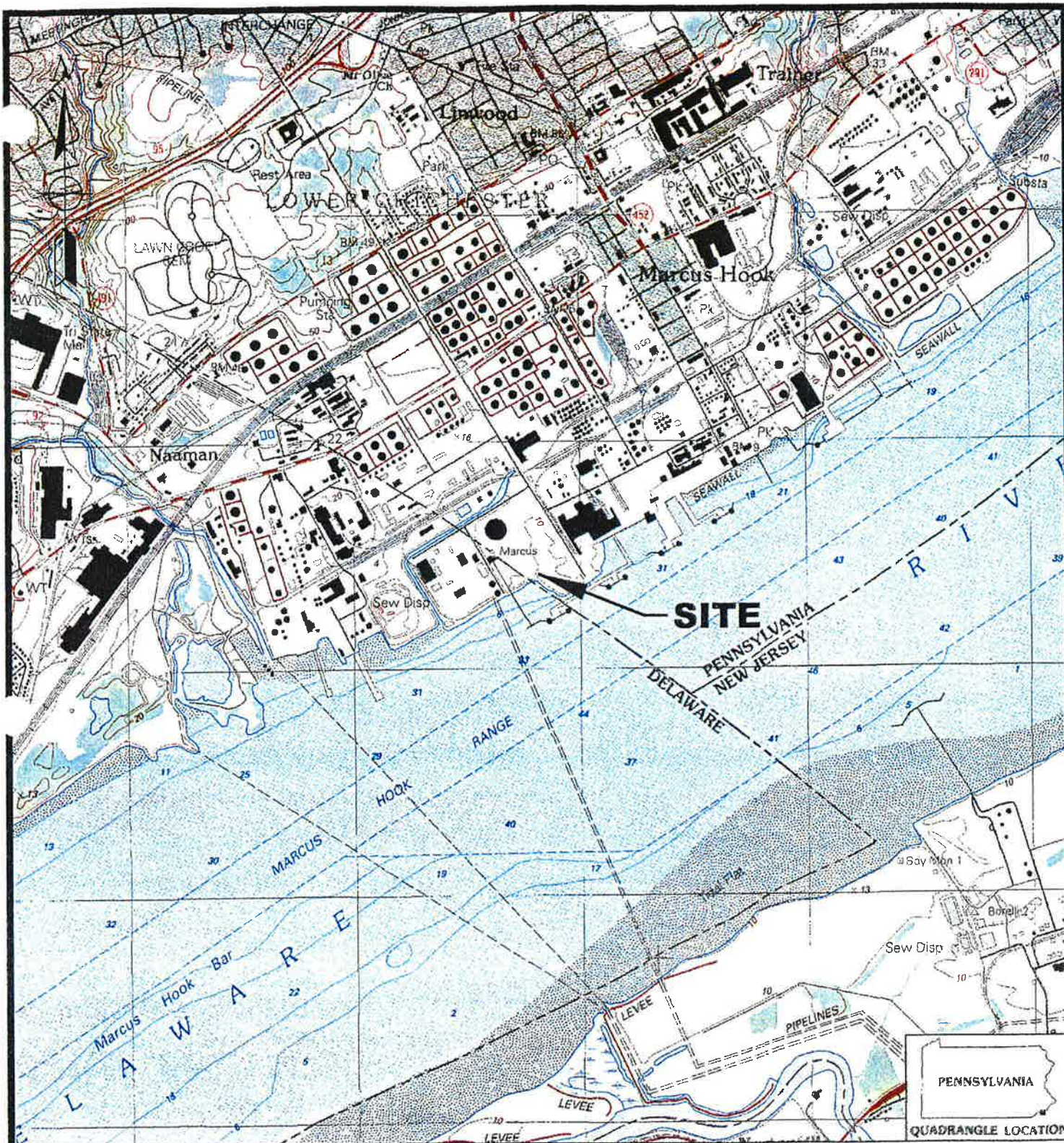
B = analyte also found in blank

D = diluted

GW = groundwater

= exceeds MSC

FIGURES



07/18/02 10:43



GRAPHIC SCALE

CONTOUR INTERVAL = 10 FEET

(2) 90813-05.

REFERENCE:
A PORTION OF USGS 7.5 MINUTE TOPOGRAPHIC
MAP; MARCUS HOOK QUADRANGLE, PENNSYLVANIA;
1993.

SITE VICINITY MAP

PROJECT

FPL ENERGY
MARCUS HOOK, PENNSYLVANIA

URS

SCALE

AS SHOWN

DATE

7/18/02

DRAWN BY

R.G.B.

APPROVED BY

J.C.S.

JOB NO.

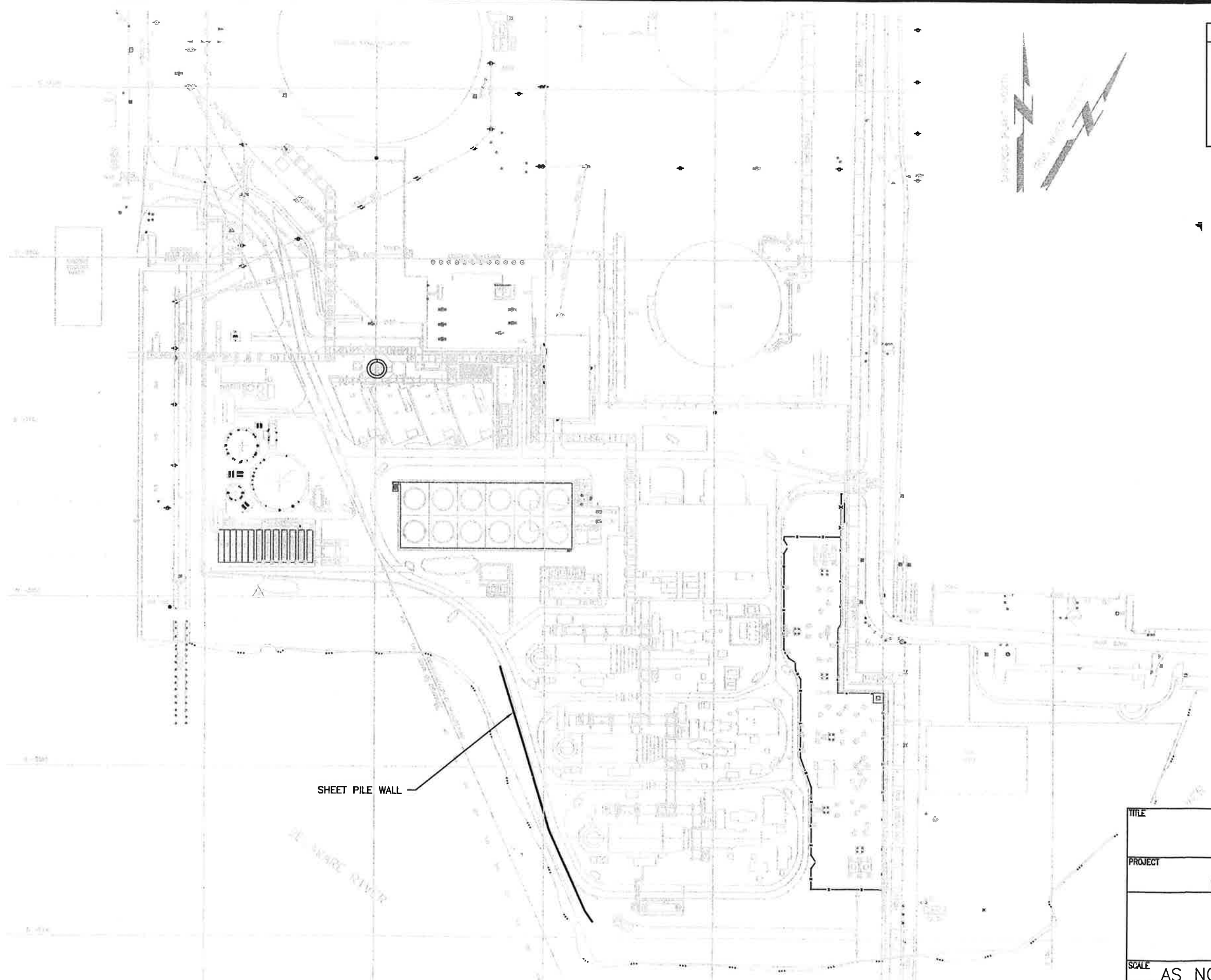
24-28488014.00

FIG. NO.

1

PENNSYLVANIA

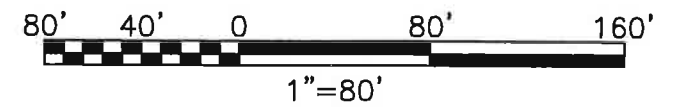
QUADRANGLE LOCATION



RECORD DRAWING:

THIS RECORD DRAWING HAS BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, URS CORPORATION CANNOT ASSURE ITS ACCURACY, AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THIS RECORD DRAWING OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO IT AS A RESULT. THOSE RELYING ON THIS RECORD DOCUMENT ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

- NOTES:**
1. BASE DRAWING: STORM DRAINAGE & SANITARY SEWER PLAN; BY STONE & WEBSTER, INC., CHERRY HILL, NEW JERSEY; DRAWING # 13260-S5-EB-1C-3.
 2. CONTRACTOR SHALL FIELD VERIFY ALL BURIED UTILITY LOCATIONS PRIOR TO COMMENCING CONSTRUCTION.
 3. ELEVATIONS SHOWN ARE REFERENCED TO FPLE VERTICAL DATUM.



TITLE			
CURRENT SITE LAYOUT			
PROJECT			
SUNOCO INC. (R&M) MARCUS HOOK, PENNSYLVANIA			
URS			
SCALE	AS NOTED	DWN. BY	TBS
DATE	12/09/04	APPR. BY	GCA
JOB NO.		19994641.00001	
FIG. NO.		2	

N -2250

N -2500

N -2750

N -3000

N -3250

N -3500



EXISTING
RIVER INTAKE

SAND
BLASTING
AREA

FIREFIGHTING
TRAINING
AREA

ROLL-OFF
CONTAINER
STAGING

LEGEND
NOT A SITE BOUNDARY

EXISTING, FIELD SURVEY, AERIAL PHOTO, AND
AERIAL PHOTO SURVEY DATA

EXHIBIT 0-1A

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000

ASME 100%

FORMER SITE LAYOUT

SUNCOCK, INC. (FIRM)

MARCOLE, HOOK, POINTE, MAINE

URS

4/19/00 11:00 A.M. 11:00 A.M. 11:00 A.M.

N -2250

N -2500

N -2750

N -3000



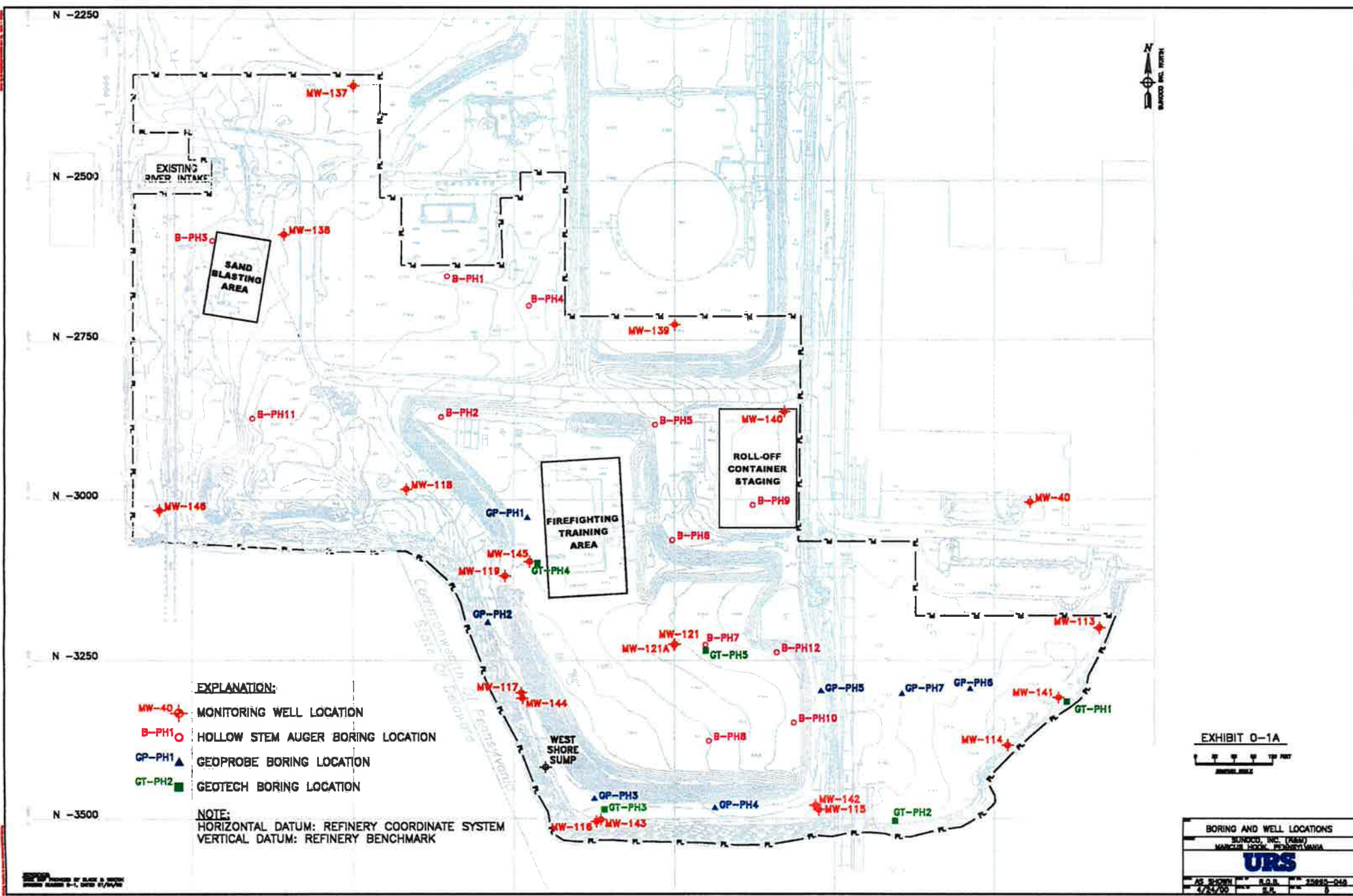
- EXPLANATION:**
- MW-40 ○ MONITORING WELL LOCATION
 - B-PH1 ○ HOLLOW STEM AUGER BORING LOCATION
 - GP-PH1 ▲ GEOPROBE BORING LOCATION
 - GT-PH2 ■ GEOTECH BORING LOCATION
 - [Light Blue Box] FILTER CLAY DEPOSITED FROM 1941 TO 1960
 - [Dark Blue Box] STONE BULKHEAD INSTALLED - 1941
 - [Pink Box] FILTER CLAY, DEMOLITION DEBRIS, RUBBLE DEPOSITED FROM 1960 TO 1965
 - [Red Box] BULKHEAD INSTALLED - 1960
 - [Light Green Box] FILTER CLAY, SLAG AND FILL DEPOSITED FROM 1965 TO 1988
 - [Dark Green Box] BERM INSTALLED 1965/1966

NOTE:
HORIZONTAL DATUM: REFINERY COORDINATE SYSTEM
VERTICAL DATUM: REFINERY BENCHMARK

EXHIBIT C-1A



HISTORIC FILL AND SHORELINE MAP			
BORDO, INC. (PENN.)			
MARBLE HOOK, PENNSYLVANIA			
URS			
AS SHOWN	P.O.B.	22893-048	
4/88/00	S.E.		4



EXPLANATION:

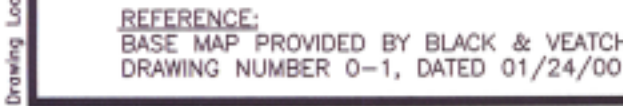
- MW-40 ◆ MONITORING WELL LOCATION
- B-PH1 ○ HOLLOW STEM AUGER BORING LOCATION
- GP-PH1 ▲ GEOPROBE BORING LOCATION
- GT-PH2 ■ GEOTECH BORING LOCATION

NOTE:
 HORIZONTAL DATUM: REFINERY COORDINATE SYSTEM
 VERTICAL DATUM: REFINERY BENCHMARK

EXHIBIT C-1A



BORING AND WELL LOCATIONS			
BUNOCO, INC. (NEW)			
MARBLE HOOK, PENNSYLVANIA			
URS			
AS SHOWN	R.O.B.	20000-048	
1/24/00	S.E.		



SCALE	AS SHOWN	OWN. BY	R.G.B.	JOB NO.	25995-046
DATE	4/24/00	APPR. BY	S.R.	FIG. NO.	6

N -2250

N -2500

N -2750

N -3000

N -3250

N -3500

EXISTING
RIVER INTAKESAND
BLASTING
AREAFIREFIGHTING
TRAINING
AREAROLL-OFF
CONTAINER
STAGING**EXPLANATION:**

- MW-40 ◆ MONITORING WELL LOCATION
 B-PH1 ○ HOLLOW STEM AUGER BORING LOCATION
 GP-PH1 ▲ GEOPROBE BORING LOCATION
 GT-PH2 ■ GEOTECH BORING LOCATION
 -20 SEDIMENT HORIZON ELEVATION
 -10 CONTOUR LINE (FEET)

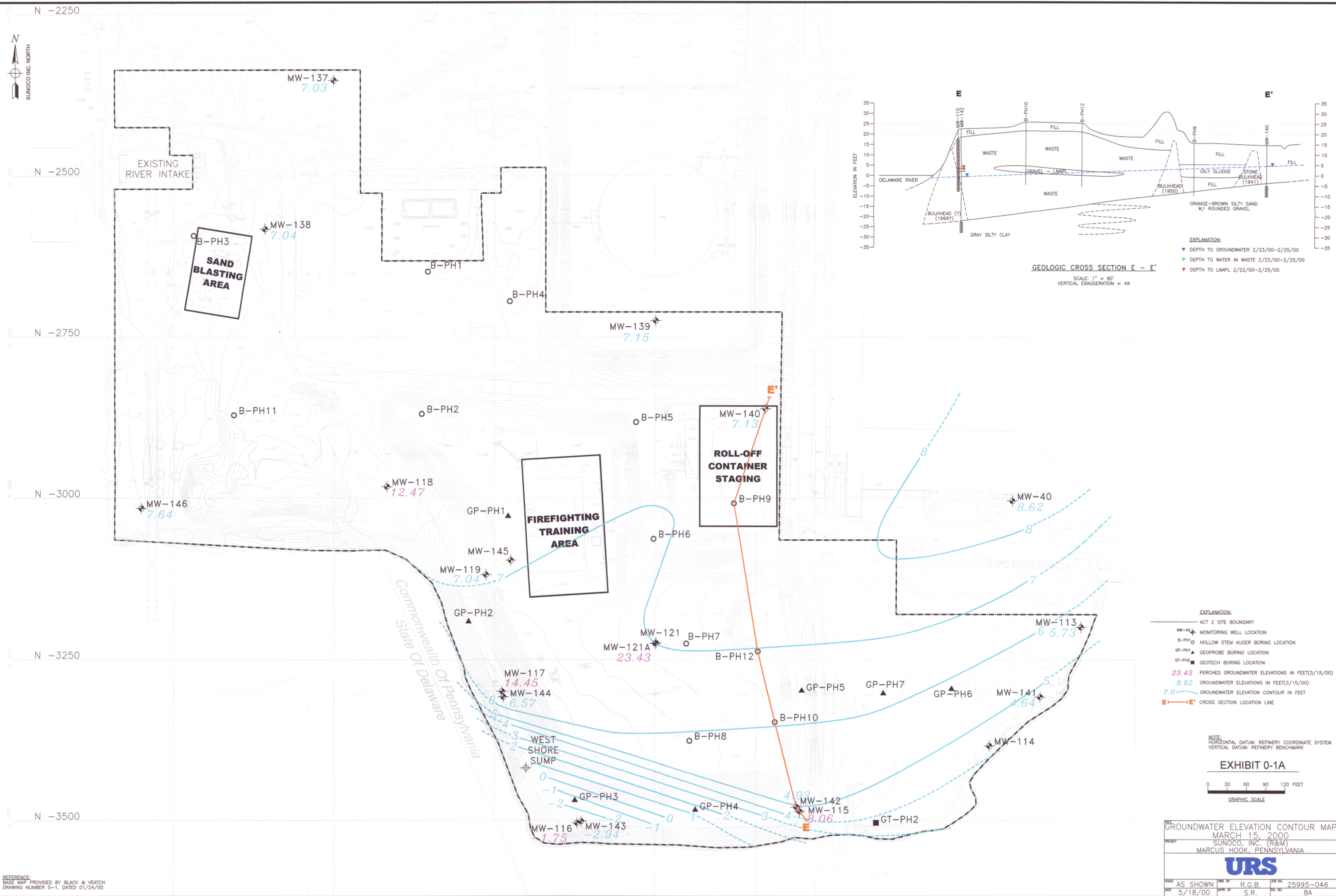
NOTE:

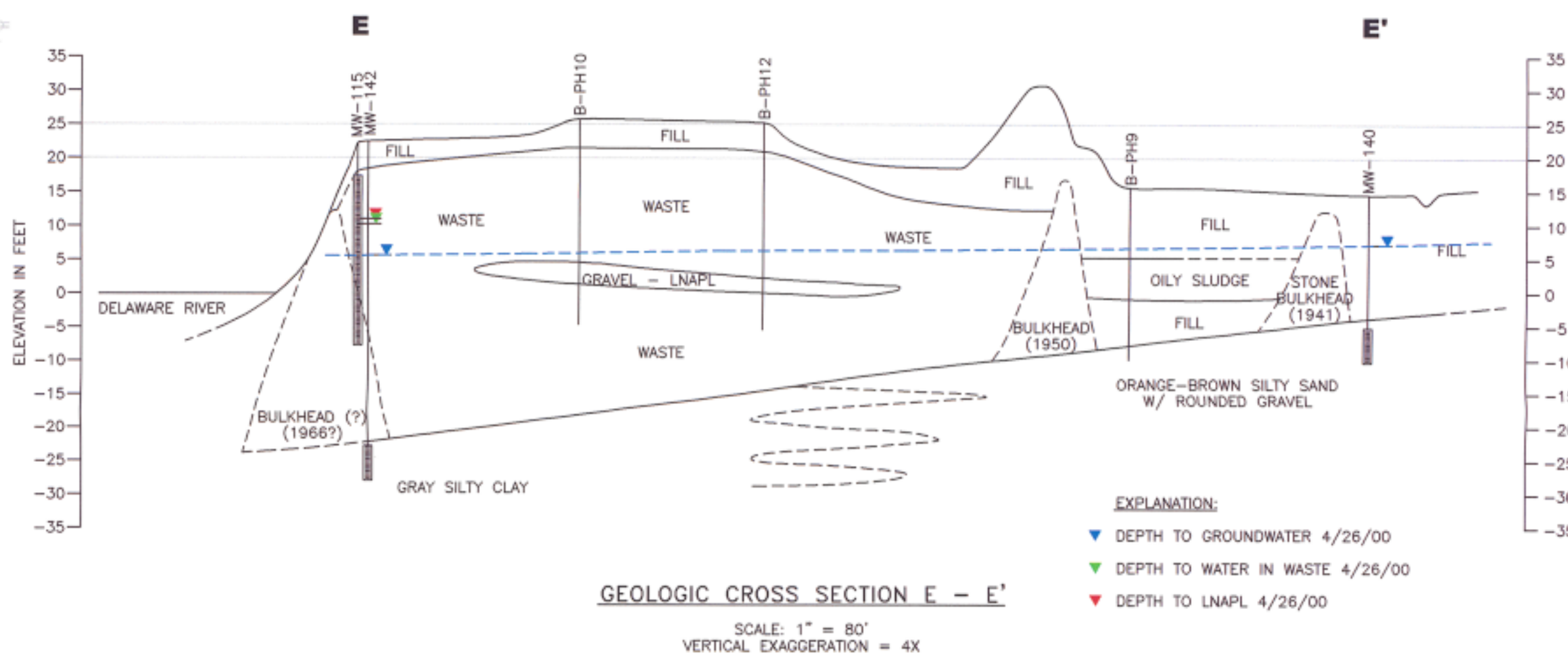
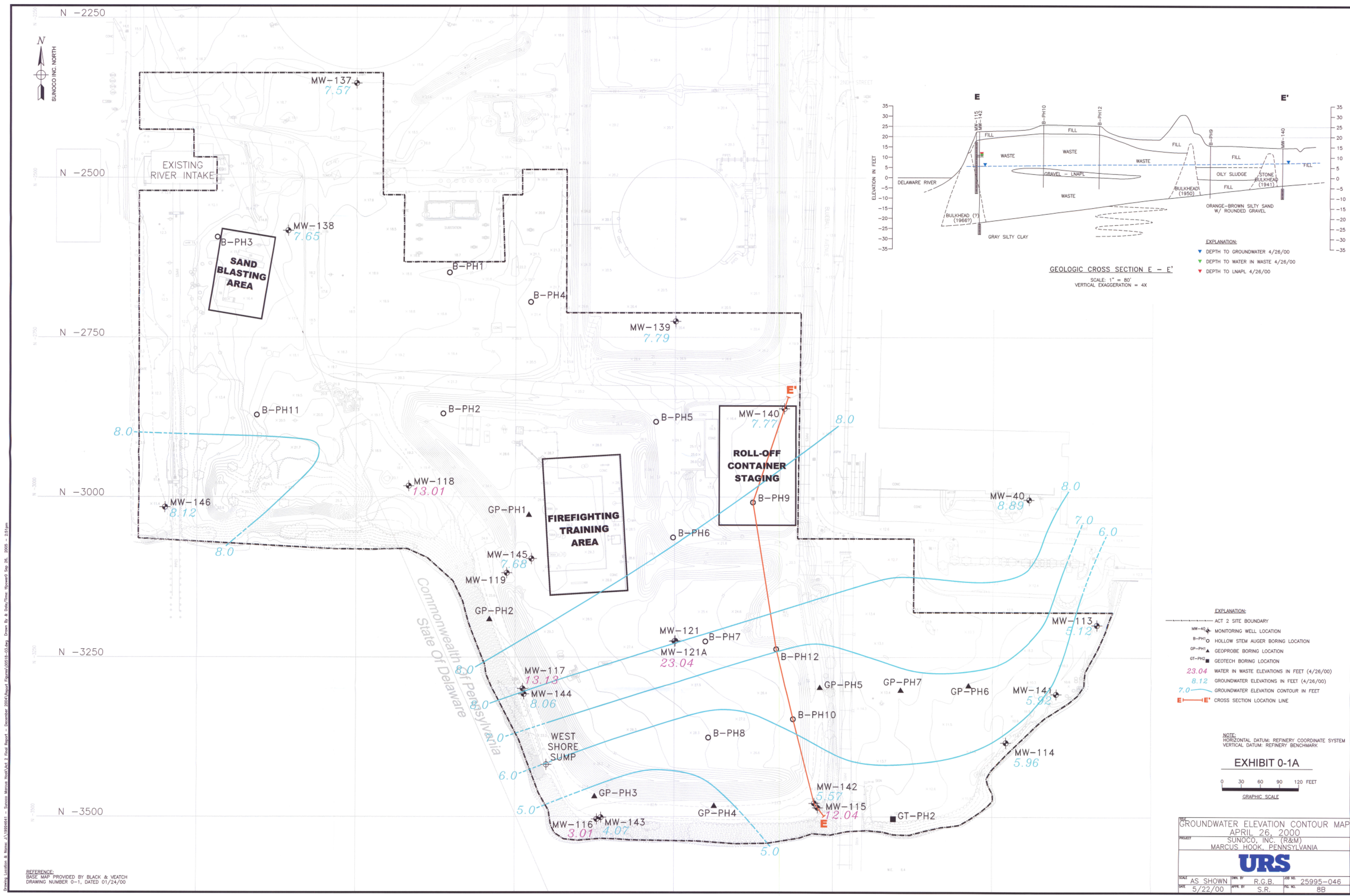
HORIZONTAL DATUM: REFINERY COORDINATE SYSTEM
 VERTICAL DATUM: REFINERY BENCHMARK

EXHIBIT 0-1A



TOPOGRAPHIC CONTOURS OF THE NATIVE SEDIMENT HORIZON		
SURVEYED BY: R. H. HARRIS		
DRAWN BY: R. H. HARRIS		
URS		
AS SHOWN	R.O.B.	22895-018
4/20/00	R.H.	





- EXPLANATION:**
- ACT 2 SITE BOUNDARY
 - MW-40 MONITORING WELL LOCATION
 - B-PH1 HOLLOW STEM AUGER BORING LOCATION
 - GP-PH1 GEOPROBE BORING LOCATION
 - GT-PH2 GEOTECH BORING LOCATION
 - 23.04 WATER IN WASTE ELEVATIONS IN FEET (4/26/00)
 - 8.12 GROUNDWATER ELEVATIONS IN FEET (4/26/00)
 - 7.0 GROUNDWATER ELEVATION CONTOUR IN FEET
 - E-E' CROSS SECTION LOCATION LINE

NOTE:
HORIZONTAL DATUM: REFINERY COORDINATE SYSTEM
VERTICAL DATUM: REFINERY BENCHMARK

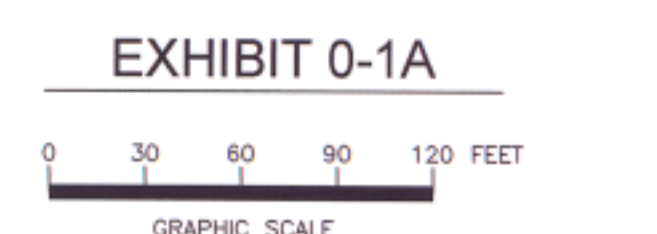


EXHIBIT 0-1A

GROUNDWATER ELEVATION CONTOUR MAP
APRIL 26, 2000
SUNOCO, INC. (R&M)
MARCUS HOOK, PENNSYLVANIA

URS

SCALE: AS SHOWN	DRAWN BY: R.G.B.	CHECKED BY: 25995-046
DATE: 5/22/00	APPROVED BY: S.R.	FILE NO.: 8B

REFERENCE:
BASE MAP PROVIDED BY BLACK & VEATCH
DRAWING NUMBER 0-1, DATED 01/24/00

Drawing Location & Name: J:\1999\441 - Sunoco Marcus Hook\Act 2 Final Report - December 2000\Figures\00018-03.dwg
Drawn By: A. Gade/Time: 10:00am 9 Sep 2000 - 2:51pm

N -2250

N -2500

N -2750

N -3000

N -3250

N -3500



EXISTING
RIVER INTAKE

B-PH3
SAND
BLASTING
AREA

FIREFIGHTING
TRAINING
AREA

ROLL-OFF
CONTAINER
STAGING

EXPLANATION:

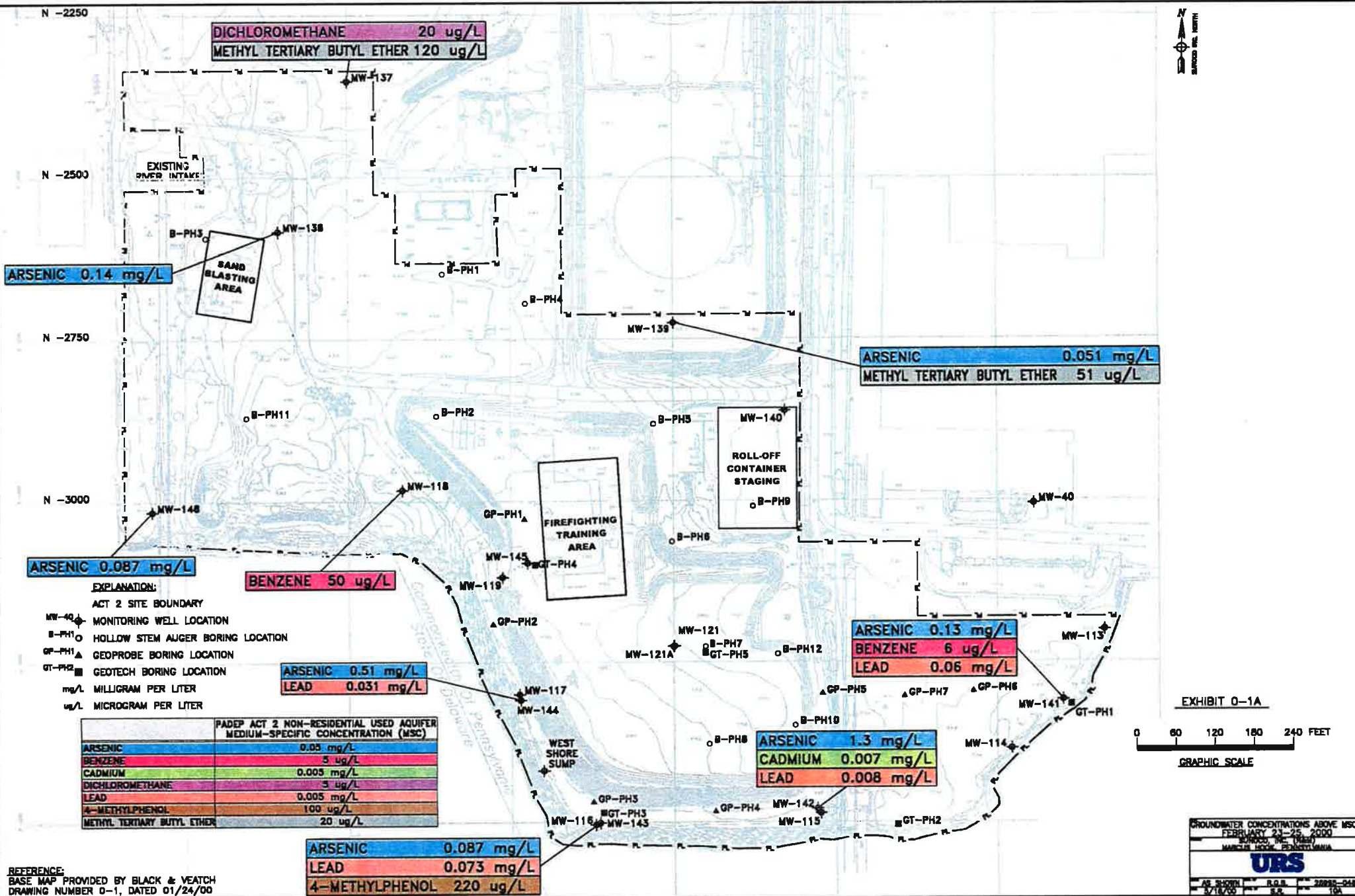
ACT 2 SITE BOUNDARY

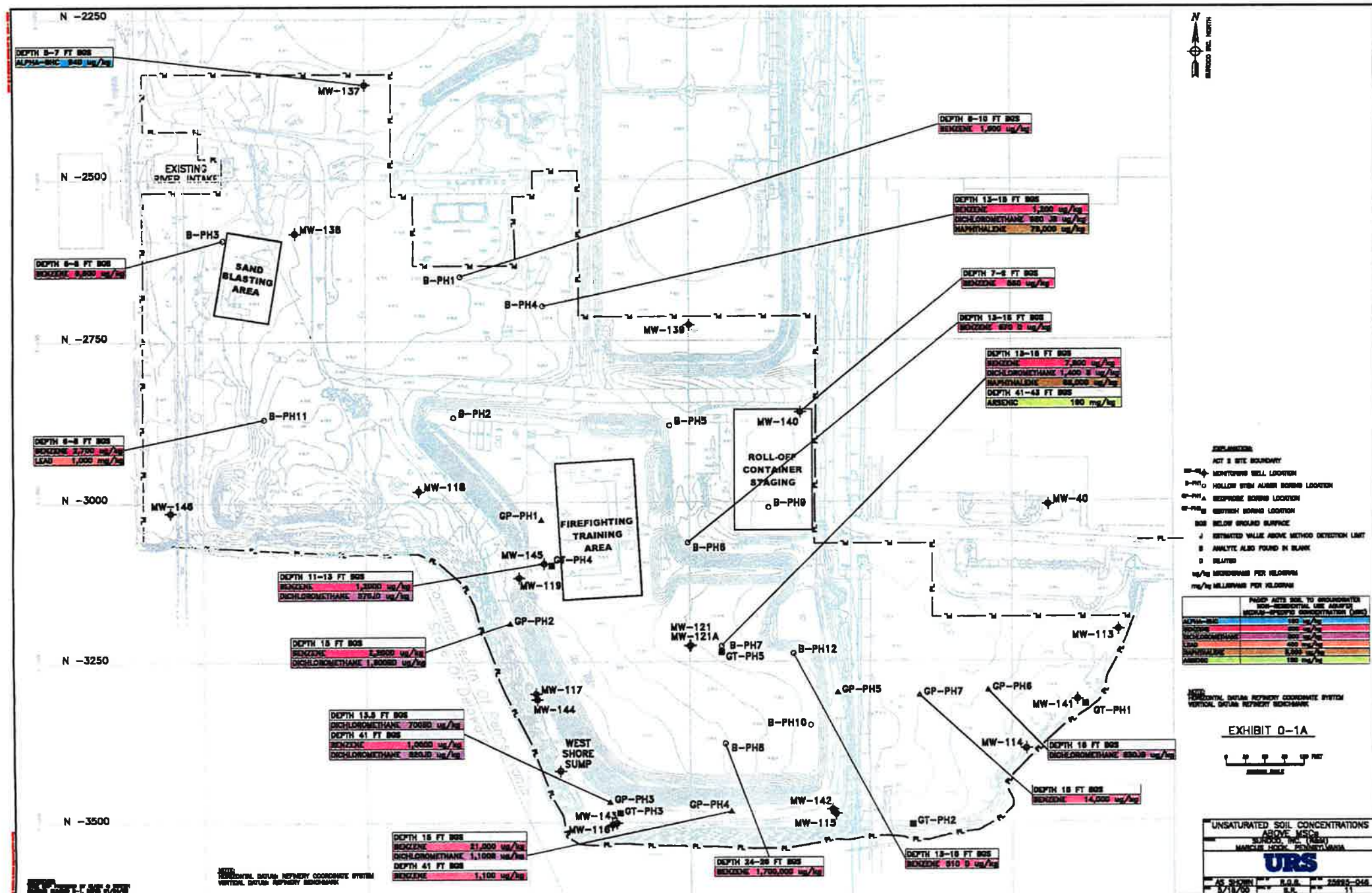
- MW-40 ◆ MONITORING WELL LOCATION
- B-PH1 ○ HOLLOW STEM AUGER BORING LOCATION
- GP-PH1 ▲ GEOPROBE BORING LOCATION
- GT-PH2 ■ GEOTECH BORING LOCATION

2/22/00 - 2/23/00 LNAPL THICKNESS
MEASUREMENTS IN FEET

EXHIBIT 0-1A
1" = 100' FEET
GRAPHIC SCALE

LNAPL THICKNESS MAP	
FEBRUARY 22-23, 2000	
SUNCO, INC. (H&M)	
MARLBOROUGH, VIRGINIA	
URS	
AS SHOWN	R.O.B.
2/18/00	S.D.
2000-016	





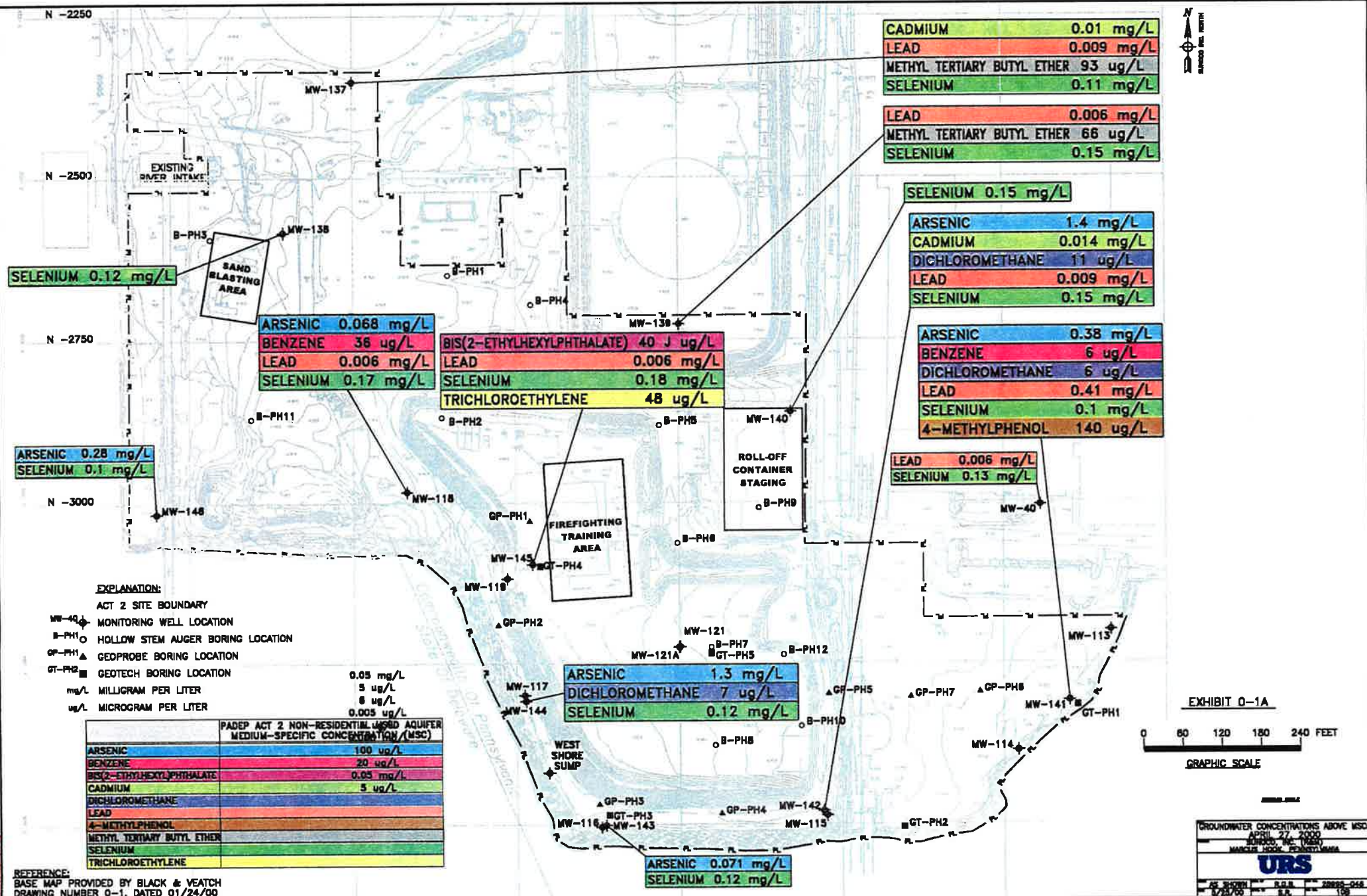
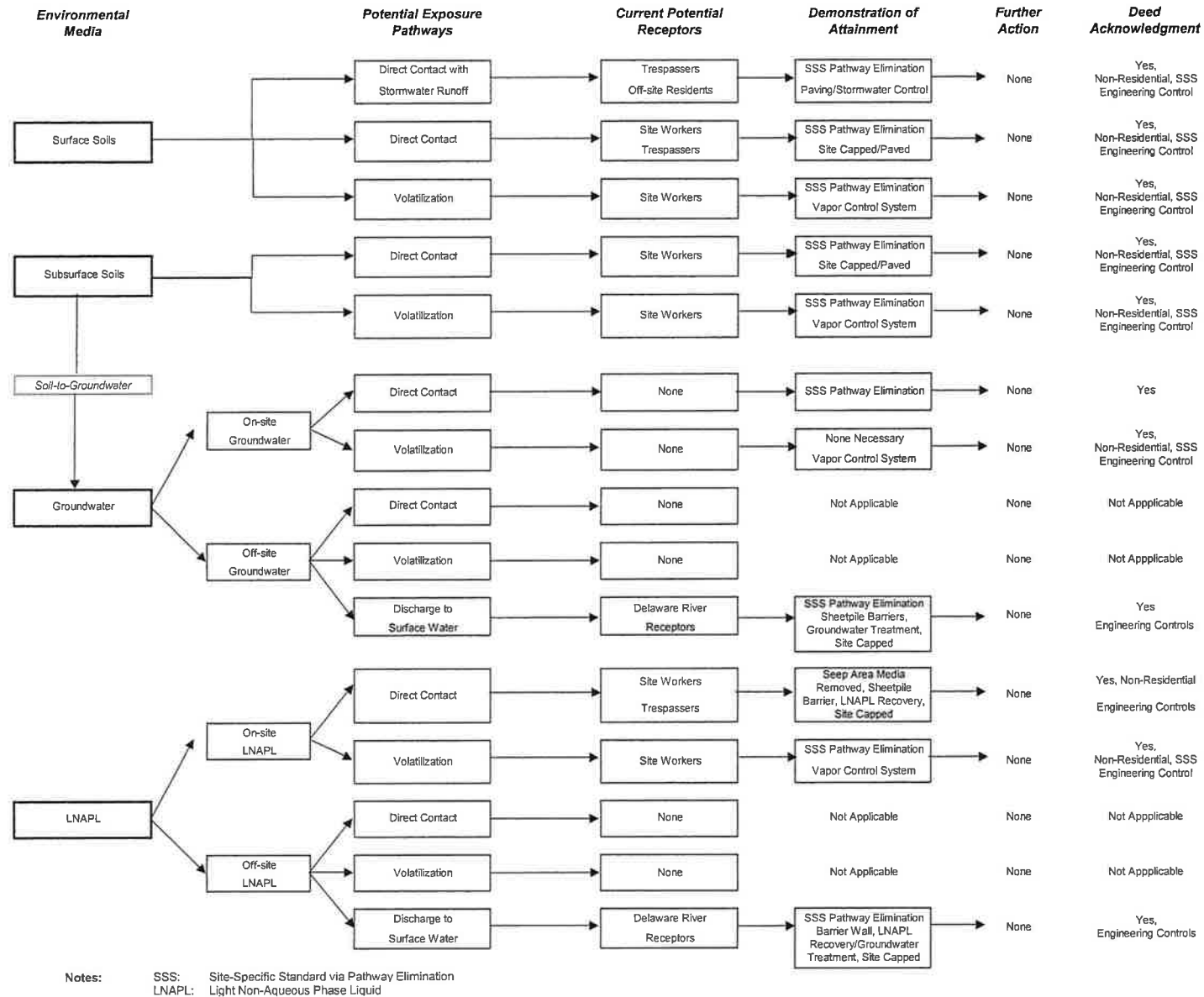


FIGURE 12

Pathway Analysis and Demonstration of Attainment
Phillips Island
Marcos Hook, Pennsylvania



Appendix A
COMMUNICATION WITH PADEP



Pennsylvania Department of Environmental Protection

Lee Park, Suite 6010
555 North Lane
Conshohocken, PA 19428
August 16, 2000

Southeast Regional Office

610-832-5949
Fax 610-832-6143

Mr. Thomas R. Bugey, P.G.
Senior Geologist
URS / Dames & Moore
2nd Floor
2325 Maryland Road
Willow Grove, PA 19090

Re: ECP Act 2 / Special Projects
Phillips Island / Florida Power Project
LRP ID# 1-23-825-28219
Sun Company
Marcus Hook Refinery
Marcus Hook Borough
Delaware County

Dear Mr. Bugey :

The Pennsylvania Department of Environmental Protection (DEP) has received and reviewed the Act 2 Combined Report dated May 31, 2000, the Response to Comments dated June 28, 2000, and the Act 2 Combined Report - Revision 1 dated July 14, 2000 for the site referenced above. Sun Company, Inc. is seeking an Act 2 release of liability for environmental conditions at this site where Florida Power hopes to build a power generating facility.

Phillips Island is a 27 acre parcel located on the Delaware River immediately north of the Delaware-Pennsylvania state boundary line. This area was filled in with wastes and other material from the 1940's to present. Material deposited there includes iron pyrites, spent filter clay, catalyst fines, leaded tank bottoms, rubble, API separator sludge, and demolition debris, along with a series of bulkheads and clay dikes. This document represents the first time a thorough environmental investigation of this area has been undertaken and reported to the DEP.

Sun will install additional engineering controls with the planned improvements to the site in an effort to eliminate potential open exposure pathways such as direct contact, vapor migration (into buildings), and seeps to the Delaware River. These improvements would be part of an Act 2 Site Specific Standard based on Pathway Elimination as described in § 250.404 and § 250.702(b)(3)(i). The submission evaluated potential open exposure pathways without quantifying the associated risks for each pathway. Data collected at the site was insufficient to determine final design criterion for proper elimination of all exposure pathways. DEP suggested that a risk evaluation be undertaken to determine

how the existing environmental conditions at the site compare to our acceptable risk ranges as described in § 250.402(b).

URS / Dames & Moore evaluated the cumulative environmental risk associated with the contaminants of concern at this site and determined that they meet the acceptable risk range of 10⁻⁴ to 10⁻⁶ excess cancer deaths and a hazard index of < 1. This demonstration was made in the document titled Act 2 Combined Report – Revision 1 dated July 14, 2000.

DEP approves the Act 2 Combined Report and Addendums and agrees with Sun Co., Inc. that existing environmental conditions at the site are within acceptable risk ranges. Additional institutional and engineering controls will be installed in conjunction with planned construction activities at the site to eliminate the direct contact exposure pathway and the vapor migration pathway. Seeps on the western shore of Phillips Island will be contained and eliminated by engineering controls and storm water will be collected and properly managed onsite to eliminate infiltration. These improvements should be documented in a final report to the DEP along with a Post Remediation Care Plan to demonstrate attainment of the Act 2 Site Specific Standard based on Elimination of Pathway.

Thank you for your cooperation in working with DEP in the remediation of this site. If you have any questions or need further information regarding this matter, please contact the Environmental Cleanup Program.

Sincerely,



Walter J. Payne
Hydrogeologist
Environmental Cleanup Program

cc: Mr. Beitler
Mr. Day-Lewis
Ms. Pantelidou
Mr. Sneath
Mr. Jardel
Mr. Breitenstein
Mr. O'Neil
Mr. Monasky
Mr. Grabusky
Mr. Barksdale
Mr. Coladonato
Regional File

Appendix B
Final Report Summary

Land Recycling Program

Submission Site for the Final Report Summaries

[Home](#) [Frequently Asked Questions](#)

Review a Final Report Summary

Final Report Summary

2005-09-23 09:28:15

Identification

Property Name: Sunoco, Inc - Marcus Hook Refinery

Property Descriptor: Phillips Island/Florida Power Project

Address/Location

Address: Sunoco Inc.
100 Green Street

City: Marcus Hook

Zip Code: 19061

Municipality

Name	Site Located
Marcus Hook borough	<input checked="" type="checkbox"/>

County: Delaware

Latitude: +39° 48' 25.578" **Longitude:** -75° 25' 17.0508"

Property Specifics

Size of property: 21.1 acres

Number of sites: 1

Combined acreage of sites: 21.1 acres

Remediation

Standards attained or special industrial area attainment. (Check all that apply. Can use multiple.)

- ☐ Background
- ☒ Statewide health
- ☒ Site-specific
- ☐ Special industrial area

Proposed future property use - scenario for which the attainment of Statewide Health standard is demonstrated

- ☐ Residential
- ☒ Non-residential

List of contaminants

See

Chemical_Name	CAS_Number	Mass Contaminant Treated or Removed (lbs.)	Mass Contaminant Managed on Site (lbs.)
OTHER COMPOUND NOT ON THE STATEWIDE HEALTH STANDARD LIST	000000-00-0	56137500.0	0.0
OTHER COMPOUND NOT ON THE STATEWIDE HEALTH STANDARD LIST	000000-00-0	0.0	0.0
ACETONE	000067-64-1	0.0	0.0
ALDRIN	000309-00-2	0.0	0.0
ANILINE	000062-53-3	0.0	0.0
ANTHRACENE	000120-12-7	0.0	0.0
ARSENIC	007440-38-2	0.0	0.0
BARIUM AND COMPOUNDS	007440-39-3	0.0	0.0
BENZENE	000071-43-2	0.0	0.0
BENZO[A]PYRENE	000050-32-8	0.0	0.0
BENZO[B]FLUORANTHENE	000205-99-2	0.0	0.0

BENZO[GHI]PERYLENE	000191-24-2	0.0	0.0
BERYLLIUM	007440-41-7	0.0	0.0
BHC, ALPHA-	000319-84-6	0.0	0.0
BHC, BETA-	000319-85-7	0.0	0.0
BHC, DELTA-	000319-86-8	0.0	0.0
BHC, GAMMA (LINDANE)	000058-89-9	0.0	0.0
BIS(2-CHLOROETHYL)ETHER	000111-44-4	0.0	0.0
BIS(2-CHLORO-ISOPROPYL)ETHER	000108-60-1	0.0	0.0
BIS[2-ETHYLHEXYL] PHTHALATE	000117-81-7	0.0	0.0
BROMODICHLOROMETHANE	000075-27-4	0.0	0.0
BROMOMETHANE	000074-83-9	0.0	0.0
CADMIUM	007440-43-9	0.0	0.0
CARBON DISULFIDE	000075-15-0	0.0	0.0
CARBON TETRACHLORIDE	000056-23-5	0.0	0.0
CHLOROANILINE, P-	000106-47-8	0.0	0.0
CHLOROBENZENE	000108-90-7	0.0	0.0
CHLOROETHANE	000075-00-3	0.0	0.0
CHLOROFORM	000067-66-3	0.0	0.0
CHLOROPHENOL, 2-	000095-57-8	0.0	0.0
CHROMIUM (III)	016065-83-1	0.0	0.0
CHRYSENE	000218-01-9	0.0	0.0
COPPER	007440-50-8	0.0	0.0
CYANIDE, FREE	000057-12-5	0.0	0.0
DDD, 4,4'-	000072-54-8	0.0	0.0
DDE, 4,4'-	000072-55-9	0.0	0.0
DDT, 4,4'-	000050-29-3	0.0	0.0
DICHLOROBENZENE, 1,2-	000095-50-1	0.0	0.0
DICHLOROBENZENE, 1,3-	000541-73-1	0.0	0.0
DICHLOROBENZIDINE, 3,3'-	000091-94-1	0.0	0.0
DICHLOROETHANE, 1,1-	000075-34-3	0.0	0.0
DICHLOROETHANE, 1,2-	000107-06-2	0.0	0.0
DICHLOROETHYLENE, 1,1-	000075-35-4	0.0	0.0
DICHLOROETHYLENE, 1,1-	000075-35-4	0.0	0.0
DICHLOROETHYLENE, CIS-1,2-	000156-59-2	0.0	0.0
DICHLOROETHYLENE, TRANS-1,2-	000156-60-5	0.0	0.0

DICHLOROMETHANE (METHYLENE CHLORIDE)	000075-09-2	0.0	0.0
DICHLOROPHENOL, 2,4-	000120-83-2	0.0	0.0
DICHLOROPROPANE, 1,2-	000078-87-5	0.0	0.0
DIELDRIN	000060-57-1	0.0	0.0
DINITROPHENOL, 2,4-	000051-28-5	0.0	0.0
DINITROTOLUENE, 2,4-	000121-14-2	0.0	0.0
DINITROTOLUENE, 2,6- (2,6-DNT)	000606-20-2	0.0	0.0
ETHYL BENZENE	000100-41-4	0.0	0.0
FLUORANTHENE	000206-44-0	0.0	0.0
HEPTACHLOR	000076-44-8	0.0	0.0
HEPTACHLOR EPOXIDE	001024-57-3	0.0	0.0
HEXACHLOROBENZENE	000118-74-1	0.0	0.0
HEXACHLOROBUTADIENE	000087-68-3	0.0	0.0
HEXACHLOROCYCLOPENTADIENE	000077-47-4	0.0	0.0
HEXACHLOROETHANE	000067-72-1	0.0	0.0
ISOPHORONE	000078-59-1	0.0	0.0
LEAD	007439-92-1	0.0	0.0
MERCURY	007439-97-6	0.0	0.0
METHYL ETHYL KETONE	000078-93-3	0.0	0.0
METHYL TERT-BUTYL ETHER (MTBE)	001634-04-4	0.0	0.0
METHYLNAPHTHALENE, 2-	000091-57-6	0.0	0.0
NAPHTHALENE	000091-20-3	0.0	0.0
NICKEL	007440-02-0	0.0	0.0
NITROANILINE, M-	000099-09-2	0.0	0.0
NITROANILINE, O-	000088-74-4	0.0	0.0
NITROANILINE, O-	000088-74-4	0.0	0.0
NITROBENZENE	000098-95-3	0.0	0.0
NITROPHENOL, 4-	000100-02-7	0.0	0.0
NITROSODI-N-PROPYLAMINE, N-	000621-64-7	0.0	0.0
NITROSODIPHENYLAMINE, N-	000086-30-6	0.0	0.0
PCB-1016 (AROCLOR)	012674-11-2	0.0	0.0
PCB-1260 (AROCLOR)	011096-82-5	0.0	0.0
PENTACHLOROPHENOL	000087-86-5	0.0	0.0
PERYANTHRENE	000085-01-8	0.0	0.0
PYRENE	000129-00-0	0.0	0.0

SELENIUM	007782-49-2	0.0	0.0
SILVER	007440-22-4	0.0	0.0
XYLENE	000100-42-5	0.0	0.0
TETRACHLOROETHANE, 1,1,2,2-	000079-34-5	0.0	0.0
TETRACHLOROETHYLENE (PCE)	000127-18-4	0.0	0.0
TOLUENE	000108-88-3	0.0	0.0
TOXAPHENE	008001-35-2	0.0	0.0
TRICHLOROBENZENE, 1,2,4-	000120-82-1	0.0	0.0
TRICHLOROETHANE, 1,1,2-	000079-00-5	0.0	0.0
TRICHLOROETHYLENE (TCE)	000079-01-6	0.0	0.0
TRICHLOROPHENOL, 2,4,6-	000088-06-2	0.0	0.0
VINYL CHLORIDE	000075-01-4	0.0	0.0
XYLENES (TOTAL)	001330-20-7	0.0	0.0
ZINC AND COMPOUNDS	007440-66-6	0.0	0.0

Groundwater

Chemical_Name	CAS_Number	Mass Contaminant Treated or Removed (lbs.)	Mass Contaminant Managed on Site (lbs.)
OTHER COMPOUND NOT ON THE STATEWIDE HEALTH STANDARD LIST	000000-00-0	0.0	0.0
ACETONE	000067-64-1	0.0	0.0
AMMONIA	007664-41-7	0.0	0.0
ANILINE	000062-53-3	0.0	0.0
ARSENIC	007440-38-2	0.0	0.0
BENZENE	000071-43-2	0.0	0.0
BENZO[A]ANTHRACENE	000056-55-3	0.0	0.0
BENZO[A]PYRENE	000050-32-8	0.0	0.0
BENZO[B]FLUORANTHENE	000205-99-2	0.0	0.0
BENZO[GHI]PERYLENE	000191-24-2	0.0	0.0
BENZO[K]FLUORANTHENE	000207-08-9	0.0	0.0
BHC, ALPHA-	000319-84-6	0.0	0.0
BIS(2-CHLOROETHYL)ETHER	000111-44-4	0.0	0.0
[2-ETHYLHEXYL] PHTHALATE	000117-81-7	0.0	0.0
CADMIUM	007440-43-9	0.0	0.0

CARBON DISULFIDE	000075-15-0	0.0	0.0
CARBON TETRACHLORIDE	000056-23-5	0.0	0.0
CHLORIDE	016887-00-6	0.0	0.0
CHLOROPHENOL, 2-	000095-57-8	0.0	0.0
CHROMIUM (III)	016065-83-1	0.0	0.0
CHRYSENE	000218-01-9	0.0	0.0
DDD, 4,4'-	000072-54-8	0.0	0.0
DIBENZO[A,H]ANTHRACENE	000053-70-3	0.0	0.0
DICHLOROBENZIDINE, 3,3'-	000091-94-1	0.0	0.0
DICHLOROETHANE, 1,1-	000075-34-3	0.0	0.0
DICHLOROMETHANE (METHYLENE CHLORIDE)	000075-09-2	0.0	0.0
DICHLOROPHENOL, 2,4-	000120-83-2	0.0	0.0
DICHLOROPROPANE, 1,2-	000078-87-5	0.0	0.0
DICHLOROPROPENE, 1,3-	000542-75-6	0.0	0.0
DICHLOROPROPENE, 1,3-	000542-75-6	0.0	0.0
DINITROPHENOL, 2,4-	000051-28-5	0.0	0.0
DINITROTOLUENE, 2,4-	000121-14-2	0.0	0.0
ETHYL BENZENE	000100-41-4	0.0	0.0
FLUORIDE	016984-48-8	0.0	0.0
FLUORIDE	016984-48-8	0.0	0.0
HEXACHLOROBENZENE	000118-74-1	0.0	0.0
HEXACHLOROBUTADIENE	000087-68-3	0.0	0.0
HEXACHLOROCYCLOPENTADIENE	000077-47-4	0.0	0.0
HEXACHLOROETHANE	000067-72-1	0.0	0.0
HEXANONE, 2- (METHYL N-BUTYL KETONE)	000591-78-6	0.0	0.0
INDENO[1,2,3-CD]PYRENE	000193-39-5	0.0	0.0
LEAD	007439-92-1	0.0	0.0
MERCURY	007439-97-6	0.0	0.0
METHYL ETHYL KETONE	000078-93-3	0.0	0.0
METHYL TERT-BUTYL ETHER (MTBE)	001634-04-4	0.0	0.0
METHYLNAPHTHALENE, 2-	000091-57-6	0.0	0.0
NITRITE NITROGEN	014797-65-0	0.0	0.0
NITROANILINE, M-	000099-09-2	0.0	0.0
NITROANILINE, O-	000088-74-4	0.0	0.0
NITROPHENOL, 4-	000100-02-7	0.0	0.0

NITROSODI-N-PROPYLAMINE, N-	000621-64-7	0.0	0.0
PENTACHLOROPHENOL	000087-86-5	0.0	0.0
PHENOL	000108-95-2	0.0	0.0
SELENIUM	007782-49-2	0.0	0.0
SULFATE	014808-79-8	0.0	0.0
TETRACHLOROETHANE, 1,1,2,2-	000079-34-5	0.0	0.0
TETRACHLOROETHYLENE (PCE)	000127-18-4	0.0	0.0
TOLUENE	000108-88-3	0.0	0.0
TRIBROMOMETHANE (BROMOFORM)	000075-25-2	0.0	0.0
TRICHLOROETHANE, 1,1,2-	000079-00-5	0.0	0.0
TRICHLOROETHYLENE (TCE)	000079-01-6	0.0	0.0
VINYL CHLORIDE	000075-01-4	0.0	0.0
XYLENES (TOTAL)	001330-20-7	0.0	0.0

Remediation

Number of sampling rounds for groundwater attainment: 0

Special Features

Non-use aquifer approval date:

Area-wide background approval date:

Amount of waste removed other than soil or groundwater (cubic yards): 3900.0

☐ **Municipal ordinance prohibiting groundwater use:**

☒ **Post remediation care plan:**

- VAPOR CONTROL: Periodic inspection of passive vapor control system PVC stack/vent pipe. - LNAPL RECOVERY SYSTEM: The LNAPL recovery system has been designed to operate unattended with routine inspection, monitoring, and maintenance. The bank and shoreline of the Delaware River will also be inspected for seeps. During the routine weekly inspections of the former seeps, the area of soil remediation will be inspected for evidence of erosion. The area will be repaired on an as-needed basis. Should a LNAPL seep reappear, corrective measures will be evaluated and implemented to address the seep and impacted soil. The effectiveness and efficiency of the pumping system will be reviewed periodically to help assure it continues to operate in accordance with its intended purpose. The containment and absorbent booms will be inspected weekly and immediately after a major storm event. Damage to the containment booms will be repaired or damaged booms will be replaced. The absorbent booms will be replaced if damaged or when the booms are at the end of their useful life. The status of the LNAPL recovery and control system operation will be incorporated into the quarterly CRP progress reports. - STORMWATER CONTROL/INFILTRATION MINIMIZATION: The integrity of the asphalt and gravel cover will be maintained to capture all stormwater on the site. If earthwork is required in the future, the stormwater collection system will be reconstructed to maintain the integrity of the system. Catch basins and piping will be

cleaned on an as needed basis.

Other Programs

- ☐ Key Site
- ☐ Multi-site Agreement; Date:
- ☐ Enterprise Zone
- ☐ Keystone Opportunity Zone

Administrative

- ☐ Municipality request for public involvement plan

Deed notification

- ☒ Deed acknowledgment:

In February 1996, as part of the RCRA closure of the Middle Creek surface impoundment, a deed notice (Amendment to I) was generated for all deeds associated with the Marcus Hook refinery property, including Phillips Island. A copy of the deed notice (Grantee's Amendment to Deed) is provided as Appendix L of the September 2005 Act 2 Final Report for the site. As indicated in the Amendment to Deed: "Pursuant to Section 265.119(b) of the U.S. Environmental Protection Agency Hazardous Waste Regulations (40 C.F.R. Part 265, Subpart G) and Section 265.119(b) of the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations (25 Pa. Code Chapter 265, Subchapter G), this Amendment is to provide the following notice to the Deeds listed above: 1. Land covered by to the aforementioned Deeds has been used to manage hazardous wastes; 2. The use of this land is restricted under the U.S. Environmental Protection Agency Hazardous Waste Regulations, 40 C.F.R. Part 265, Subpart G, and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.117(c); and 3. The survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the hazardous waste disposal unit of the facility required by the U.S. Environmental Protection Agency Regulations, 40 C.F.R. 265.116 and 265.119(a), and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.119(a), has been filed with the Marcus Hook Borough, the Lower Chichester Township, the Pennsylvania Department of Environmental Protection, and the U.S. Environmental Protection Agency." In the event the property is transferred to a new owner, this Final Report, which acknowledges that a combination of non-residential SHS and SSS were attained at the Site, that the Site is limited to non-residential use, and which contains descriptions of the engineering controls and groundwater use restrictions applicable to the future use of the Site, will also be filed with the Marcus Hook Borough, the Lower Chichester Township, and the Pennsylvania Department of Environmental Protection.

- ☒ Deed restriction:

The use of this land is restricted under the U.S. Environmental Protection Agency Hazardous Waste Regulations, 40 C.F.R. Part 265, Subpart G, and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.117(c).

Cleanup cost (\$): 781000.0

Jobs created/saved: 25

Narrative

Sunoco, Inc. (R&M) (Sunoco) retained URS Corporation (URS) to assist Sunoco in implementing remedial work pursuant to Pennsylvania's Land Recycling and Environmental Remediation Standards Act (Act 2) 35 P. S. § 6026.101 et seq., and the regulations promulgated by the Pennsylvania Department of Environmental Protection at 25 Pa Code Chapter 250 ("Act 2 regulations") pertaining to the Administration of the Land Recycling Program, for a portion of their Marcus Hook, Pennsylvania refinery referred to as Phillips Island. Upon attainment of an Act 2 Standard, Cleanup Liability Protection is afforded pursuant to Chapter 5 of Act 2. Sunoco conducted Act 2 remedial work in connection with agreements with FPL Energy Marcus Hook, L. P. ("FPLE") under which FPLE constructed a Co-generation plant, and new standby refinery boilers at the Marcus Hook Refinery. The Co-generation facility was constructed on 21.1 acres of Phillips Island which is approximately 27 acres in size. The Pennsylvania and Delaware state border passes through the site. Of the 21.1 acres, approximately 4 acres are located in Delaware. FPLE's Co-generation facility is fueled with natural gas and is designed to produce 750-megawatts of electricity per day. FPLE has also constructed new standby boilers for use by the refinery that are also fueled with natural gas. The initial phase of the Act 2 remedial work included a site characterization, remedial investigation, risk assessment, development of appropriate remedial alternatives, and preparation of a cleanup plan. The scope of these tasks was consistent with Act 2 and Act 2 regulations. The remedial work was conducted in the second phase and is comprised of engineering controls for pathway elimination. As indicated in this Report, Sunoco has achieved either the Statewide Health Standards in Act 2, or a Site-specific Standard under Act 2 using engineering controls for pathway elimination. Engineering controls used at Phillips Island included the following:

- Passive vapor control beneath occupied co-generation plant buildings;
- Enhanced LNAPL recovery and seepage elimination with a barrier;
- Removal of impacted soil from around the seep near the top of the west bank of the berm; and
- Stormwater control and infiltration minimization.

The results of the initial phase of the Act 2 program were presented in a report titled Act 2 Combined Report – Revision 1 dated July 14, 2000 (July 2000 Combined Report). Analytical results from the remedial investigation were compared to the statewide health standard soil to groundwater pathway and direct contact exposure medium-specific concentrations (MSCs) to identify chemicals of potential concern (COPCs). The analytical results indicate that many of the regulated substances are below the medium-specific concentrations and accordingly meet the statewide health standards. For surface and subsurface soils, the detection limits for several of the semi-volatile organic compounds (SVOCs) were above either the non-residential used aquifer soil to groundwater pathway MSCs or the surface and subsurface direct contact MSCs. To assess the potential for these compounds to be present above the MSCs, they were included in the exposure characterization. A Site-specific Standard was achieved for these compounds using engineering controls for pathway elimination. Evaluation of the potential exposure pathways under current and future use scenarios concluded the following:

- There are no potable wells in use at or downgradient of the site. Groundwater ingestion and groundwater dermal contact are not complete exposure routes of concern. Occupied co-generation plant buildings include a passive vapor control system, thereby eliminating the potential for worker exposure inside buildings. This engineering control eliminates the groundwater vapor inhalation exposure pathway.
- The potential soil exposure pathway for workers on Phillips Island is through direct contact. However, the site has been covered with asphalt and clean gravel to eliminate the potential soil direct contact exposure scenario. Under the current use scenario, the soil direct contact pathway has been eliminated utilizing these engineering controls for pathway elimination. The addition of asphalt and clean gravel surfaces (engineering controls) at the site are also utilized to control and collect stormwater and prevent stormwater contact with site soils.
- Model results indicate that surface water quality standards will not be exceeded. Therefore, surface water direct contact with dissolved compounds is not an exposure pathway of concern.
- In the light non-aqueous phase liquid (LNAPL) sample, only one COPC was detected and at a concentration below the non-residential used aquifer soil to groundwater pathway MSC (used for screening purposes). Though the chemical composition of the LNAPL does not pose a threat to human health or the environment, the physical discharge of the LNAPL is considered a potentially complete pathway. Therefore, a sheet pile barrier wall was installed to prevent possible further seepage to the River.
- The evaluation of ecological receptors indicated there is a lack of complete

exposure pathways. Based on the results of the remedial investigation and risk evaluation, remedial actions were developed for the site and included in the cleanup plan. Following PADEP approval of the proposed remedial actions, Sunoco and FPLE constructed the remedial systems in conjunction with the co-generation plant site redevelopment. Major components of the overall remedy for the site include: 1. Enhanced LNAPL recovery and seepage elimination with a barrier wall. 2. Removal of impacted soil from around the seep near the top of the west bank of the berm (completed as part of the barrier wall installation). 3. Passive vapor control beneath occupied co-generation plant buildings. 4. Stormwater control and infiltration minimization. The enhanced LNAPL recovery system includes a series of new recovery wells in the berm along the bank of the Delaware River. To eliminate seeps, a sheet pile barrier wall was placed in the area of the seeps along a portion of the western bank of Phillips Island. LNAPL adjacent to the barrier is being removed with the enhanced recovery system. Interim measures, consisting of a floating boom and absorbent in the area of the seeps, are maintained to prevent the migration of LNAPL to the river. The boom was maintained during the installation of the barrier wall and maintenance will continue after LNAPL residuals riverside of the barrier wall have dissipated. Impacted soil around the seep near the top of the west bank of the berm was removed to eliminate the direct contact exposure pathway. The co-generation plant was designed and constructed to eliminate potential exposure routes of constituents of concern resulting from historic land uses. Mechanisms for pathway elimination include a vapor control system beneath all buildings occupied by workers. The ground surface has been covered with either gravel or asphalt to remove the potential for worker and ecological receptor direct contact with surface soil. Stormwater is collected by overland flow and subsurface drains and channeled to the plant cooling towers which minimizes both the infiltration rate to the subsurface and the use of potable water for non-contact cooling. Construction and ongoing operation of these measures has eliminated exposure pathways (direct contact and inhalation) and mitigate potential migration of compounds detected at the site. Since the startup of the enhanced LNAPL recovery system in March 2004, Sunoco has recovered a total of approximately 3,900 gallons of LNAPL (as of the end of November 2004). This represents a recovery rate of approximately 400 gallons of LNAPL per month. In addition, the seeps once present along the west berm have ceased. This data indicates that the remedial actions implemented at the site are attaining the objectives of eliminating potential exposure pathways, control of LNAPL and groundwater migration, and improvements to subsurface conditions. Therefore, the remedial work has achieved Site-specific Standards under Act 2 using engineering controls for pathway elimination.

Remediator/Property Owner/Consultant

Contact Person: Jim Oppenheim

Title: Property owner

Phone Number: 6108591881

Email Address: jroppenheim@sunocoinc.com

Company Name: Sunoco Inc. (R&M)

Address: 100 Green Street
Marcus Hook, PA 19061

Contact Person: Glenn Randall

Title: Consultant

Phone Number: 2153672500

Email Address: Glenn_Randall@urscorp.com

Company Name: URS Corporation

Address: 335 Commerce Dr., Suite 300
Ft. Washington, PA 19034

Attachments (Note: Click the file name will open a new window.)

Print this final report summary

Update this final report summary

Update another final report summary

Review another final report summary

Submit another final report summary

Appendix C
Soil Boring Logs & Well Construction Details



DAMES & MOORE

A TAYLOR & HOBBS GROUP COMPANY

Borehole #: GP-PH1(GP-1)

Boring Location: Phillips Island

Project: Phase II





Client: FPLE/Sunoco

Date: March 14, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Gravel Fill		MC	2.0	
4				0.0	
6					
8	Silty Clay Fill		MC	50	(8 for VOC's)
10	Gray to black silty clay w/ gravel, medium to coarse sand, hydrocarbon-like odor, oily residue, very wet.			4.2	
12				3.6	
14				3.6	
16				0.0	
18	Clayey Silt Waste		MC	1.0	
20	Dark gray clayey silt, hydrocarbon-like odor, oily residue, very wet.			0.0	
22	Silty Clay Fill			3.2	
24	Dark gray to black silty clay w/ some coarse sand, hydrocarbon-like odor, oily residue, wet.				
	End of Borehole, Refusal @ 18.5 ft.				

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb 7, 2000

Elevation: 29.32

Drill Method: Geoprobe

Finish Date: Feb. 7, 2000

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR & HOBSON GROUP COMPANY

Borehole #: GP-PH2(GP-2)

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 14, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill Yellowish brown silty clay w/ sand, gravel, hydrocarbon-like odor, moist.		MC	12.5	(17 for VOC's)
4	Gray to dark gray silty clay w/ sand, gravel, hydrocarbon-like odor, some oily residue, moist, tightly compacted, high plasticity.				
6	Silty Sand Waste Yellowish brown to gray silty sand w/ gravel, hydrocarbon-like odor, moist, loosely compacted, medium plasticity, white waxy material present.		MC	15	
8	Silty Clay Fill Dark gray to black silty clay w/ gravel and cobble, hydrocarbon-like odor, some oily residue, moist, medium compaction, medium plasticity, concrete fragments present.		MC	12.6	
10	Olive green to dark gray silty clay w/ some sand and gravel, hydrocarbon-like odor, some oily residue, moist, medium compaction, high plasticity.		MC	13.6	
12					
14			MC	11	
16	Dark gray to black silty clay w/ sand and gravel, hydrocarbon-like odor, some oily residue, moist, medium compaction, high plasticity			17	
18			MC	11	
20				6.9	
22	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, some oily residue, moist, loosely compacted, high plasticity.			7.5	
24	Dark gray to black silty clay w/ gravel, hydrocarbon-like odor, oily residue, fairly moist, medium compacted, high plasticity		MC	7.2	
26				14.1	
28			MC	18.2	
30				24.5	
32	End of Borehole @ 32 ft. Ran out of rods.		MC	92.4	
34			25.3		
			21.9		

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 11, 2000

Elevation: 25.30

Drill Method: Geoprobe

Finish Date: Feb. 16, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A DAIWA S&M GROUP COMPANY

Borehole #: GP-PH3(GP-3)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Waste				
4	Olive green to dark gray silty clay w/ gravel, hydrocarbon-like odor, moist, medium compaction, high plasticity.		MC	2.9	
6			MC	9	
8	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, oily residue, moist, medium compaction, high plasticity.		MC	2	
12	Free product present @ 12 ft.			1	(13 for VOC's)
16	Olive green to black silty clay, hydrocarbon-like odor, moist, tightly compacted, high plasticity, free product present.		MC		
18			MC		
20			MC		
22			MC		
24					
26					
28					
30			MC		
32	Olive green to black silty clay, hydrocarbon-like odor, moist, medium compaction, high plasticity, free product present.		MC		
34			MC		
36					
38			MC		
40	Olive green to black silty clay, hydrocarbon-like odor, moist to wet, medium compaction, high plasticity, free product present.		MC		
42			MC		
44					
46	Olive green to dark gray silty clay w/ orange sand, hydrocarbon-like odor, moist to wet, medium compaction, high plasticity, some free product present.		MC		
48	Natural material @ 45.5 ft.				
50	End of Borehole @ 48 ft.				
52					

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 12, 2000

Elevation: 22.83

Drill Method: Geoprobe

Finish Date: Feb. 16, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR S. & MOORE GROUP COMPANY

Borehole #: GP-PH4(GP-4)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill				
4	Olive green to dark gray silty clay, hydrocarbon-like odor, moist, medium compaction, high plasticity.		MC	6.0	
6	Silty Clay Waste			4.3	
8	Oily residue (staining) @ 4 ft.		MC		
10	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, very moist, medium compaction, high plasticity.		MC		
12	Yellowish orange staining, wood and brick fragments.			16.3	
14	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, brick fragments, very moist, medium compaction, high plasticity.		MC	19.0	
16			MC	9.3	(15 for VOC's)
18					
20					
22	Olive green to dark gray silty clay, brick fragments, hydrocarbon-like odor, very moist, medium compaction, high plasticity.		MC		
24					
26	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, oily residue, moist, medium compaction, high plasticity.		MC	1.2	
28					
30	No Recovery.		MC	7.5	
32					
34	Silty Clay Fill				
36	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, very moist to wet, medium compaction, high plasticity.		MC	4.6	
38			MC	12.7	
40					
42	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, very moist, loosely compacted, high plasticity.		MC	24.4	
44	Natural material @ 42 ft.				
46	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, moist, medium compaction, high plasticity.		MC	9.3	
48	Orange coarse sand @ 44 ft.				
50	End of Borehole @ 48 ft.				
52					

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 14, 2000

Elevation: 21.58

Drill Method: Geoprobe

Finish Date: Feb. 16, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A TIAW S & MOORE GROUP COMPANY

Borehole #: GP-PH5(GP-5)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0	Silty Clay Fill Yellowish brown silty clay, some gravel, fairly moist, medium compaction.		MC	0.0	(12 for VOC's)
2				0.0	
4	Gravel layer.			0.0	
4	Silty Clay Waste Gray to dark gray silty clay, some gravel, fairly moist, tightly compacted.		MC	0.0	
6					
8	Olive green to dark gray silty clay, hydrocarbon-like odor, oily residue, very moist, tightly compacted.			0.0	
10				2.3	
12			MC	6.9	
14					
16					
18					
20	End of Borehole @ 20ft. Ran out of rods.				
22					
24					

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 9, 2000

Elevation: 19.71

Drill Method: Geoprobe





Finish Date: Feb 16, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A DAMES & MOORE GROUP COMPANY

Borehole #: GP-PH6(GP-6)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
	Gravel Fill				
2	Silty Clay Fill Gray to dark gray silty clay w/ some sand and gravel, hydrocarbon-like odor, oily residue, fairly moist.		MC	0.0	
4	Yellowish brown silty clay w/ some gravel, hydrocarbon-like odor, oily residue, wet.				
6				2.3	
8	Silty Sand Fill Medium to dark gray silty sand w/ some gravel, brick fragments, hydrocarbon-like odor, oily residue, very moist.		MC	8.1	
10	Silty Clay Waste Medium to dark gray silty clay, hydrocarbon-like odor, moist.				
12				8.4	
14				0.0	
16	End of Borehole @ 16 ft.		MC	24.8	(16 for VOC's)
18					
20					

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 7, 2000

Elevation: 11.79

Drill Method: Geoprobe




Finish Date: Feb. 7, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HOOD GROUP COMPANY

Borehole #: GP-PH7(GP-7)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
	Gravel Fill				
2	Silty Clay Fill Yellowish brown silty clay w/ sand and gravel, moist. Wood chips and particles @ 3 ft.		MC	1.3 1.7 1.6	
4	Gray to dark gray silty clay w/ sand and gravel, hydrocarbon-like odor, oily residue, very moist.				
6	Silty Clay Waste		MC	4.2	
8	Large amount of free product present @ 8 ft.			16.4	
10			MC	16.0 7.9	
12				8.5	
14			MC	23.0	(15 for VOC's)
16	End of Borehole @ 16 ft.				
18					
20					

Note: Temp. casing installed.

Hole Size: 2 in.

Drilled By: Tri State Env. Mngmt. Services, Inc.

Start Date: Feb. 7, 2000

Elevation: 13.12

Drill Method: Geoprobe

Finish Date: Feb. 7, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A DAWSON GROUP COMPANY

Borehole #: B-PH1 (MW-1)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 14, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0	Silty Clay Fill Dark brown silty clay w/ sand and gravel, moist to wet, melting snow in area.		MC	1.8	(0-2)
2	Brick layer.				
4	Sand and aggregate.				
6	Black silty clay /w brick fragments and gravel, hydrocarbon-like odor.				
8			MC	2.9	(8-10)
10	Light brown silty clay, hydrocarbon-like odor.				
12	Brown silty clay w/ brick fragments.				
14					
16	Black silty clay, hydrocarbon-like odor.		MC	23.3	(17-19)
18					
20					
22					
20	Silty Sand Fill Orange brown silty sand w/ rounded gravel.		MC	0.9	(21-23)
22	Orange brown silty sand w/ gravel, wet, slight hydrocarbon-like odor.				
24	End of boring, refusal @ 23 ft.				
26					
28					
30					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 10, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 10, 2000





Elevation: 19.93

Sheet: 1 of 1

**DAMES & MOORE**

A DAW S & MOORE GROUP COMPANY

Borehole #: B-PH2 (B-2)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 8, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill Yellowish brown to dark gray silty clay w/ 20% gravel, slight hydrocarbon odor, tightly compacted, high plasticity, very moist.		MC	0.0	(0-2)
4					
6			MC	0.0	
8					
10			MC	0.0	(10-12)
12					
14	No Recovery		MC	0.0	
16	Silty Clay Fill Yellowish brown to dark gray silty clay, some gravel, hydrocarbon odor, oily residue, tightly compacted, high plasticity, very wet. Olive green to yellowish brown to dark gray silty clay, hydrocarbon odor, oily residue, medium compaction, high plasticity, very wet.		MC	12.5	
18					
20					
22			MC	35.2	(22-24) (23 for VOCs)
24					
26			MC	6.4	
28	Olive green to dark gray silty clay, hydrocarbon odor, oily residue, loose to medium compaction, high plasticity, very wet.				
30			MC	4.2	
32					
34			MC	0.0	
36	Medium gray silty clay mixed w/ orange medium grained silty sand, hydrocarbon odor, tightly compacted, medium plasticity, moist.				
38			MC	0.0	(37-39)
40	Olive green to dark gray silty clay hydrocarbon odor, loosely compacted, high plasticity, very wet.				
42	End of Borehole @ 39 ft.				
44					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 14, 2000

Hole Size: 2 in.

Drill Method: Geoprobe

Finish Date: Feb. 15, 2000

Elevation: 27.48

Sheet: 1 of 1

**DAMES & MOORE**

A DAWI S & MOORE GROUP COMPANY

Borehole #: B-PH3 (B-3)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 9, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0	Gravelly Silt		MC	0.8	(0-2)
2	Orange-brown gravelly silt w/ sand aggregates, brick fragments, moist.			1.3	
	Black staining present @ 2 ft.			1.4	
4				2.7	
6				3.9	
6			MC	3.5	(6-8)
8				5.1	
8				2.1	
10				3.2	
10				1.8	(9-11)
12	Silty Sand		MC	1.6	
12	Silty sand w/ rounded gravel, wet, black staining.			1.2	
14	Natural Soil			3.4	(14-16)
14	Orange-brown where not stained.				
16	End of Borehole @ 16 ft.				
18					
20					
22					
24					
26					
28					
30					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 22, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 22, 2000

Elevation: 14.81

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR & HOBBS GROUP COMPANY

Borehole #: B-PH4 (B-4)

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 9, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill Medium brown silty clay w/ sand and gravel aggregate, moist. Wood fragments @ 3 ft.		MC	0.1 0.1 0.4 0.7 0.6	(0-2)
6					
8	No Recovery from 5-10 ft.				
10			MC		
12	Silty Clay Fill Medium brown silty clay w/ sand, moist, slight hydrocarbon-like odor. Black staining @ 14 ft.			5.6 1.7 1.8 1.1 3.4 6.9 5.3 4.4 9.1 15.4	(13-15)
14					
16			MC		
18					
20	Silty Clay Mottled gray/brown silty clay, hydrocarbon-like odor, moist to wet. Natural? Mottled gray/brown silty clay, moist to wet, somewhat structural. Natural?			1.4 0.7 0.4 0.1 0.1	(18-20)
22	Sand Coarse sand layer, wet, rainbow sheen on liquid.				
24	Clayey Silt Orange brown clayey silt w/ sand, wet w/ some fine rounded gravel and some large gravel. End of Borehole @ 25 ft.				(23-25)
26					
28					
30					

Drilled By: Tri State Env. Mngmt. Services Inc.

Start Date: Feb. 8, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 8, 2000

Elevation: 21.00

Sheet: 1 of 1

**DAMES & MOORE**

A DAWSON & MOORE GROUP COMPANY

Borehole #: B-PH5 (B-5)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 10, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Shawn Miller

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill Yellowish brown silty clay w/ sand & gravel, moist, medium compacted, high plasticity.		MC	0.0	(0-2)
4	Olive green to dark gray silty clay, moist, hydrocarbon-like odor, oily residue, medium compacted, high plasticity, brick, gravel, metal fragments mixed in.		MC	1.2	
6	Silty Clay Waste				
10			MC	4.3	
12	Olive green to dark gray silty clay, fairly moist, hydrocarbon-like odor, medium compacted, high plasticity, little gravel.				(11-13)
14			MC	1.4	
16	Olive green to dark gray silty clay, moist, hydrocarbon-like odor, residue, medium to tight compaction, high plasticity.		MC		
20	Olive green to dark gray silty clay, hydrocarbon odor, moist, medium compaction, high plasticity.				
22			MC		(22-24)
24					
26	Silty Clay Natural Material Olive green to dark gray silty clay, hydrocarbon-like odor, moist, medium compacted, high plasticity.		MC		(24-26)
28	Orange silty sand w/ rounded pebbles				
30	End of Borehole, refusal @ 26.5 ft.				

Drilled By: Tri State Env. Mngmt. Services Inc.

Start Date: Feb. 15, 2000

Hole Size: 2 in.

Drill Method: Geoprobe

Finish Date: Feb. 15, 2000

Elevation: 24.18

Sheet: 1 of 1



DAMES & MOORE
A TAYLOR & HOBBS GROUP COMPANY

Borehole #: B-PH6 (B-6)

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 10, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0	Silty Clay Fill Olive gray to dark gray silty clay, some gravel, hydrocarbon-like odor, somewhat moist, medium compaction, high plasticity.		MC		(0-2)
2					
4	oily residue, fairly wet.		MC		
6			MC		
8					
10			MC		
12	Silty Clay Waste Light gray to dark gray silty clay, some sand and gravel, hydrocarbon-like odor, oily residue, moist, medium compaction, high plasticity.		MC		(13-15)
14					
16			MC		
18			MC		
20	Oily sludge layer, silty clay, viscous, some gravel.				
22			MC		
24			MC		(23-25)
26	End of Borehole @25 ft.				
28					
30					

Drilled By: Tri State Env. Mngmt. Services Inc.

Start Date: Feb. 15, 2000

Hole Size: 2 in./6 1/4 in.

Drill Method: Geoprobe (18.5), Hollow Stem Auger (25)

Finish Date: Feb. 16, 2000

Elevation: 22.40

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR & HOBBS GROUP COMPANY

Borehole #: B-PH7 (B-7)

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 10, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill				(0-2)
4	Aggregate, brown silty clay w/ sand, brick fragments.		MC	0.5	
6					
8			MC	0.0	
10					
12	Black staining present, hydrocarbon-like odor @ 12 ft.		MC	1.5	
14					(13-15)
16					
18			MC	1.4	
20	Silty Clay Waste				
22	Gray brown silty clay, some black staining @ 18 ft.				
24	Gray brown silty clay w/ black staining.		MC	0.4	
26					
28	Moist to wet.		MC	0.0	
30					
32			MC	2.1	
34					
36					
38			MC	1.9	
40					
42	Gray brown silty clay w/ black staining.		MC	14.7	(41-43)
44					
46	Rounded gravel present, small amount of sand.				
48	Clayey Silt				
50	Gray brown clayey silt w/ sand and gravel, structure present, natural material.		MC	2.1	(48-50)
52	Some orange to gray mottled sand @ 48 ft.				
54	End of Borehole @ 50 ft.				

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 16, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 16, 2000

Elevation: 25.17

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HOBBS GROUP COMPANY

Borehole #: B-PH8 (B-8)**Boring Location:** Philips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 10, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill				(0-2)
4	Fine gravel, brown silty clay, aggregates, metal and brick fragments.		MC	4.2	
6	Brown to dark brown silty clay, some fine gravel, slight hydrocarbon-like odor, some staining, moist.		MC	11.2	
8					(7-9)
10	Wet @ 9 ft.				
12					
14	Tan clay w/ some silt, hydrocarbon-like odor, w/ some black staining.		MC	5.4	
16					
18	Silty Sand Fill		MC	17.1	
20	Red brown silty sand w/ clay, hydrocarbon-like odor, w/ some staining, moist.				
22	Silty Clay Waste				
24	Tan brown silty clay, w/ some black staining, wet.		MC		
26	Tan brown silty clay, hydrocarbon-like odor, w/ some black staining, LNAPL present, moist to wet.			625	(24-26)
28	Concrete fragments, some fine gravel present.		MC	149.7	
30					
32					
34	Dark brown silty clay w/ some gravel, wax fragment, slight hydrocarbon-like odor, moist to wet.		MC		
36	duct tape in cutting shoe @ 35 ft..			23.5	
38			MC	21.6	
40	Wax fragments @ 38 ft..				
42	Dark brown silty clay w/ some gravel, fabric, burlap, hose, slight hydrocarbon-like odor, moist to wet.		MC		
44	Silty Clay Natural Material				
46	Brown silty clay, some black staining, moist to wet, natural material.			32.4	
48			MC		
50				44.6	(48-50)
52	End of Borehole 50 ft.				
54					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 7, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 7, 2000

Elevation: 27.84

Sheet: 1 of 1

**DAMES & MOORE**

A DAWSON GROUP COMPANY

Borehole #: B-PH9 (B-9)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 10, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Silty Clay Fill Brown silty clay w/ brick fragments and aggregates, hydrocarbon-like odor, moist.		MC		(0-2)
4	Some black staining @ 3.5 ft.				
6					
8			MC		(8-10)
10	Non-aqueous liquid present, sample is non-aqueous saturated, black silty clay w/ gravel, essentially an oily sludge, difficult to sample for VOA, volume in sample bottles may not be correct due to sludge sticking to syringe and difficulty in weighing samples.				
12					
14			MC		(13-15)
16	Sampler refusal @ 16 ft., oily sludge in sample.				
18					
20	Brown silty clay.				
22					
24	Silty Sand Fill Orange brown silty sand w/ gravel .				(23-25)
26	End of Borehole @ 25 ft.				
28					
30					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 12, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 12, 2000

Elevation: 15.73

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HOBBS GROUP COMPANY

Borehole #: B-PH10 (B-10)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 10, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0-2	Clayey Silt Fill brown clayey silt w/ gravel, sand, and aggregate, brick fragments.		MC	8.0	(0-2)
2-9	Silty Clay Fill Medium brown silty clay w/ some gravel, hydrocarbon-like odor. Medium brown silty clay, hydrocarbon-like odor, moist		MC	6.4 11.2	(7-9)
9-10	Wet @ 9.75 ft.			1.6	
10-12	Medium brown silty clay, hydrocarbon-like odor, some black staining, moist to wet.		MC	0.7	
12-16	Clay very tightly compacted, somewhat drier than surrounding clays.			9.5	
16-22	Silty Clay Waste		MC	64.7	
22-24	Non aqueous liquid present, medium brown silty clay w some black staining, sample coated w/ non aqueous liquid which is dark brown to black colored. Gravel layer, non aqueous liquid saturated, 22-23 ft.		MC	37.8 29.7	(22-24)
24-28	Silty clay w/ black staining, non aqueous liquid present, may be gravitating down from above.			25.7	
28-30	End of non aqueous liquid @ 27 ft.		MC	33.6 17.4	(28-30)
30-32	End of Borehole @ 30 ft., stopped due to 3 ft. of non aqueous liquid in auger, so as not to allow it to go any deeper.				

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: Feb. 8, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: Feb. 8, 2000

Elevation: 25.76

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & MOORE GROUP COMPANY

Borehole #: B-PH11 (B-1)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 11, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Sampler Type	PID (ppm)	Sample Depth
0	Ground Surface				
0	Sand				
2	Medium to fine sandblasting material.			1.0	(0-2)
2	Silty Clay		MC	3.3	
4	Medium/light brown silty clay.				
4	Black/gray silty clay, slight hydrocarbon-like odor, moist.				
6	Wood fragments present @ 5 ft.		MC	9.3	(6-8)
8				24.7	
10			MC	14.6	(10-12)
12				18.8	
14			MC	4.7	
16				5.0	
18			MC	14.6	
20	Structure present, gray brown silty clay w/ some sand.				
20	Gray brown silty clay w/ some fine sand.				
22			MC	8.9	(22-24)
24	End of boring @ 24 ft.				
26					
28					
30					

Drilled By: Tri State Env. Mngmt.Services Inc.

Start Date: March 2, 2000

Hole Size: 6 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 2, 2000

Elevation: 14.09

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & MOORE GROUP COMPANY

Borehole #: B-PH12 (MW-7)**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 17, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Type	PID (ppm)	Sample Depth
0	Ground Surface				
2	Aggregate				(0-2)
4	Silty Clay Fill Medium brown silty clay w/ brick fragments, aggregates.		MC		
6	Some black staining, hydrocarbon-like odor.		MC		
8	Silty Clay Waste				
10	Medium brown silty clay w/ gravel, sand, black staining present, hydrocarbon-like odor.				
12					
14	Non-aqueous liquid present.		MC		(13-15)
16	Rock fragments, sampler drove rock.				
18			MC		
20					
22	Medium brown silty clay, moist, black stained.		MC		
24					
26	Medium brown silty clay, gravel, black stained, 1-2 ft. non-aqueous liquid present.		MC		
28					
30	End of Borehole @ 30 ft., above native material and no well constructed due to presence of LNAPL.		MC		(28-30)
32					
34					

Start Date: Feb. 11, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Elevation: 25.25

Finish Date: Feb. 11, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A DAME & MOORE GROUP COMPANY

Monitoring Well #: MW-137

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 16, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Orange brown silty sand w/ rounded gravel, wet				(0-2)	Elevation (Feet)
2	Orange brown sandy silt w/ clay and gravel.					Ground Inner Outer
4						16.10 19.22 19.36
6	Clayey Silt Fill				(5-7)	Well constructed with 2 in.
8	Brown clayey silt w/ sand, fine rounded gravel, hydrocarbon-like odor, moist to wet.			0.4		schedule 40 pvc screen and casing.
10				0.9		
12	Obstruction @ 11 ft.			0.4	(8-10)	Well completed with 3 ft. of stickup and 3 1/4 ft. of steel casing.
14	Silty Sand					Former Well#: MW-3
16	Orange brown silty sand w/ gravel coarse sand, wet. Natural?					
18	Coarse sand w/ silt, wet @ 15 ft.					
20	Orange brown silty sand w/ rounded gravel, wet.			0.2	(18-20)	
22	End of Borehole @ 20 ft.					
24						
26						
28						
30						

Start Date: Feb. 9, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4

Finish Date: Feb. 10, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR S. & MOORE GROUP COMPANY

Monitoring Well #: MW-138

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 16, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0					(0-2)	Elevation (Feet)
2	Silty Clay Fill					Ground Inner Outer
	Medium brown silty clay w/ sand and aggregates.					16.94 20.01 20.17
4				0.5		
6	Some black staining present @ 5 ft.					Well constructed with 2 in. schedule 40 pvc screen and casing.
8	Some tar-like material present @ 8 ft.				(8-10)	Well completed with 3 ft. of stickup and 3 ft. of steel casing.
10				0.7		
12					(12-14)	Former Well #: MW-4
14	Moist to wet.			4.2		
16						
18	Sandy Silt Fill					
	Orange brown sandy silt w/ rounded gravel, wet.			0.9		
20	Orange brown sandy silt /w rounded gravel, wet.					
22	Brown sand w/ silt and fine gravel, wet.			1.1		
24	Silty Sand Fill				(23-25)	
	Gray/red sand, Orange brown silty sand w/ rounded gravel, wet.					
26	End of Borehole @ 25 ft.					
28						
30						

Start Date: Feb. 14, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 14, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HOBSON GROUP COMPANY

Monitoring Well #: MW-139**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 16, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Clayey Silt Fill Brown clayey silt, wet, wood fragments, aggregates.				(0-2)	Elevation (Feet) Ground Inner Outer 20.27 22.91 23.06
2						
4						
6	Silty Clay Fill Brown silty clay w/ sand and gravel, wet, slight hydrocarbon-like odor.					Well constructed with 2 in. schedule 40 pvc screen and casing.
8						
10	Silty Clay Mottled brown/orange silty clay, moist to wet.			4.2	(8-10)	Well completed with 2 3/5 ft of stickup and 2 3/4 ft. of steel casing.
12						
14						Former Well #: MW-6
16	Red/orange mottled silty clay w/ sand and gravel.			1.8	(17-19)	
18						
20	Orange brown sand and gravel w/ silty clay, wet, slight hydrocarbon-like odor.			0.9		
22						
24	End of Borehole @ 25 ft.				(23-25)	
26						
28						
30						

Start Date: Feb. 10, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4

Finish Date: Feb. 10, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1

**DAMES & MOORE**

A HAWKINS & MOORE GROUP COMPANY

Monitoring Well #: MW-140**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 16, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Clayey Silt Fill Medium brown clayey silt w/ sand and gravel, aggregates.			1.2 0.7	(0-2)	Elevation (Feet) Ground Inner Outer 14.82 17.80 17.90
2						
4	Silty Clay Fill Brown to dark brown silty clay w/ sand and gravel, hard/dry, hydrocarbon-like odor.					Well constructed with 2 in. schedule 40 pvc screen and casing.
6	Brown silty clay, moist to wet, hydrocarbon-like odor.				(7-9)	Well completed with 3 ft. of stickup and 3 ft. of steel casing.
8						
10	Brown silty clay w/ some wood fragments, wet, hydrocarbon-like odor present.			1.7 3.0	(16-18)	Former Well #: MW-2
12						
14						
16						
18						
20	Silty Sand Red/orange brown silty sand w/ rounded gravel, wet, hydrocarbon-like odor, native soil.				(23-25)	
22	Orange brown coarse sand w/ silt, moist to wet, some rounded gravel.					
24	Orange brown sandy silt w/ clay, mottled, moist.					
26	End of Borehole @ 25 ft.					
28						
30						

Start Date: Feb. 9, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 9, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE
A DAWSON GROUP COMPANY

Monitoring Well #: MW-141

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 16, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Silty Clay Fill					Elevation (Feet)
2	Orange brown silty clay w/ sand and aggregates.					Ground Inner Outer
	Gray brown silty clay w/ sand and gravel.					10.07 12.83 13.26
4	Black staining present, hydrocarbon-like odor @ 4 ft.					
6						Well constructed with 2 in. schedule 40 pvc screen and casing.
8						
10						Well completed with 2 3/4 ft. of stickup and 3 1/5 ft. of steel casing.
12						
14						
16						
18	Some structure present. Native?					Former Well #: MW-1
	Gray silty clay w/ some fine sand and silt.					
20						
22						
24						
26	End of Borehole @ 25 ft.					
28						
30						

Start Date: Feb. 16, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 16, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A DAIWA & MOORE GROUP COMPANY

Monitoring Well #: MW-142

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 17, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Silty Clay Fill					Elevation (Feet)
2	Olive green to dark gray silty clay, hydrocarbon-like odor, moist, medium compaction, high plasticity.					Ground Inner Outer
4	Oily residue (staining).					22.18 24.78 25.29
6						Well constructed with 2 in. schedule 40 pvc screen and casing.
8	Olive green to dark gray silty clay, hydrocarbon-like odor, residue, very moist, medium compaction, high plasticity.					Well completed with 2 1/2 ft. of stickup and 3 ft. of steel casing.
10	Yellowish orange staining, wood and brick fragments.					Former Well #: MW-11
12	Olive green to dark gray silty clay, hydrocarbon-like odor, residue, brick fragments, very moist, medium compaction, high plasticity.					Lithology and PID readings from nearby GP-PH4.
14						
16	Olive green to dark gray silty clay, brick fragments, hydrocarbon-like odor, very moist, medium compaction, high plasticity.					
18						
20	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, residue, moist, medium compaction, high plasticity.					
22						
24						
26						
28						
30	No Recovery.					
32						
34	Silty Clay Fill					
36	Olive green to dark gray silty clay, hydrocarbon-like odor, residue, very moist to wet, medium compaction, high plasticity.					
38						
40	Olive green to dark gray silty clay, hydrocarbon-like odor, residue, very moist, loosely compacted, high plasticity.					
42	Natural material @ 42 ft.					
44						
46	Olive green to dark gray silty clay, hydrocarbon-like odor, residue, moist, medium compaction, high plasticity.					
48						
50	Orange coarse sand.					
52	End of Borehole @ 48 ft.					
54						

Start Date: Feb. 15, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 15, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A DAMES & MOORE GROUP COMPANY

Monitoring Well #: MW-143

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 17, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0						
2	Silty Clay Fill			2.9		Elevation (Feet) Ground Inner Outer 23.32 26.18 26.02
4	Olive green to dark gray silty clay w/ gravel, hydrocarbon-like odor, moist, medium compaction, high plasticity.					
6						Well constructed with 2 in. schedule 40 pvc screen and casing.
8	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, residue, moist, medium compaction, high plasticity.			9		
10				2		Well completed with 2 4/5 ft. of stickup and 2 3/4 ft. of steel casing.
12	Free product present.			1	(13 for VOC's)	
14						Former Well #: MW-9
16						Lithology and PID readings taken from GP-PH3, which is located nearby.
18						
20						
22	Olive green to black silty clay, hydrocarbon-like odor, moist, tightly compacted, high plasticity, free product present.					
24						
26						
28						
30						
32						
34	Olive green to black silty clay, hydrocarbon-like odor, moist, medium compaction, high plasticity, free product present.					
36						
38						
40						
42	Olive green to black silty clay, hydrocarbon-like odor, moist to wet, medium compaction, high plasticity, free product present.					
44						
46	Olive green to dark gray silty clay w/ orange sand, hydrocarbon-like odor, moist to wet, medium compaction, high plasticity, some free product present.					
48						
50						
52	Natural material @ 45.5 ft.					
54	End of Borehole @ 48 ft.					

Start Date: Feb 14, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 14, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A TIAAM S & MOORE GROUP COMPANY

Monitoring Well #: MW-144

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 17, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Silty Clay Fill					Elevation (Feet)
2	Yellowish brown silty clay w/ sand, gravel, hydrocarbon-like odor, moist.					Ground Inner Outer
4						22.36 24.91 25.06
6	Gray to dark gray silty clay w/ sand, gravel, hydrocarbon-like odor, some residue, moist, tightly compacted, high plasticity.					Well constructed with 2 in. schedule 40 pvc screen and casing.
8						Well completed with 2 1/2 ft. of stickup and 2 3/4 ft. of steel casing.
10	Silty Sand Fill					
12	Yellowish brown to gray silty sand w/ gravel, hydrocarbon-like odor, moist, loosely compacted, medium plasticity, white waxy material present.					Former Well #: MW-8
14						Lithology, and PID readings taken from GP-PH2, which is located nearby.
16	Silty Clay Fill					
18	Dark gray to black silty clay w/ gravel and cobble, hydrocarbon-like odor, some residue, moist, medium compaction, medium plasticity, concrete fragments present.					
20						
22	Olive green to dark gray silty clay w/ some sand and gravel, hydrocarbon-like odor, some residue, moist, medium compaction, high plasticity.					
24						
26	Dark gray to black silty clay w/ sand and gravel, hydrocarbon-like odor, some residue, moist, medium compaction, high plasticity					
28						
30	Olive green to dark gray silty clay w/ some gravel, hydrocarbon-like odor, some residue, moist, loosely compacted, high plasticity.					
32						
34	Dark gray to black silty clay w/ gravel, hydrocarbon-like odor, residue, fairly moist, medium compacted, high plasticity					
36						
38						
40	No lithological description from 32 ft. down.					
42						
44						
46						
48						
50	End of Borehole @ 50 ft.					
52						
54						

Start Date: Feb. 15, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 15, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HOBSON GROUP COMPANY

Monitoring Well #: MW-145**Boring Location:** Phillips Island**Project:** Phase II**Client:** FPLE/Sunoco**Date:** March 16, 2000**Project No:** 25995-046**Site Address:** Marcus Hook, PA**Field Personnel:** Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Aggregates and brick fragments.				(0-2)	Elevation (Feet) Ground 28.60 Inner 31.51 Outer 31.66
2	Clayey Silt Fill (1-5 ft.)					
4	Red brown clayey silt w/ sand and gravel, brick fragments.			11.4		Well constructed with 2 in. schedule 40 pvc screen and casing.
6				5.7		Well completed with 3 ft. of stickup and 3 ft. of steel casing.
8	Silty Clay Fill (5-9 ft.)					
10	Brown/tan silty clay w/ sand and gravel, hydrocarbon-like odor.					
12	Sandy Silt Fill (9-11 ft.)				(11-13)	Former Well #: MW-5
14	Brown sandy silt w/ gravel.					
16	Concrete			11.4		
18	Clayey Silt Fill (11-23 ft.)					
20	Orange brown clayey silt, moist, hydrocarbon-like odor, some black staining.				(18-20)	
22	Silty clay, moist, hydrocarbon-like odor, black stained.			27.8		
24	Brown Silty Clay w/ gravel, wet, non aqueous liquid present.				(23-25)	
26				16.6		
28	Medium brown silty clay, moist, hydrocarbon-like odor, black stained.			18.7		
30	Silty Sand Fill (23-24.5 ft)					
32	Brown silty sand w/ clay and white granular material, wet, hydrocarbon-like odor.					
34	Silty Clay Fill (24.5-43.5 ft.)					
36	Brown silty clay w/ black staining.					
38	Brown silty clay, moist, slight hydrocarbon-like odor.					
40	Brown silty clay, moist, slight hydrocarbon-like odor.					
42						
44	Clayey Silt					
46	Red/green brown mottled clayey silt.					
48	Silty Sand			3.5	(48-50)	
50	Orange brown silty sand w/ gravel.					
52	Clayey Silt					
54	Gray clayey silt w/ some sand.					
54	End of Borehole @ 50 ft.					

Start Date: Feb. 11, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4

Finish Date: Feb. 11, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1



DAMES & MOORE

A DAIWA & MOORE GROUP COMPANY

Monitoring Well #: MW-146

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 17, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Well Construction	PID (ppm)	Sample Depth	Remarks
0	Clayey Silt Fill				(0-2)	Elevation (Feet)
2	Orange/brown clayey silt w/ sand, aggregates, brick fragments, stiff, some rounded gravel.					Ground Inner Outer
4						10.97 13.68 13.84
6					(5-7)	Well constructed with 2 in. schedule 40 pvc screen and casing.
8	Wet @ 7 ft.			0.3		
10	Clayey silt w. some sand and rounded gravel, slight hydrocarbon-like odor, black staining present, some structure to soil.				(9-11)	Well completed with 2 3/4 ft. of stickup and 3 ft. of steel casing.
12						Former Well #: MW-10
14	Dark brown clayey silt.			0.7		
16	Orange brown clayey silt.					
18	Dark brown clayey silt.					
20	End of Borehole @ 20 ft.			1.3	(18-20)	
22						
24						
26						
28						
30						

Start Date: Feb. 22, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: Feb. 22, 2000

Drill Method: Hollow Stem Auger

Sheet: 1 of 1

**DAMES & MOORE**

A DAWSON GROUP COMPANY

Borehole #: GT-1**Boring Location: Phillips Island****Project: Phase II****Client: FPLE/Sunoco****Date: March 21, 2000****Project No: 25995-046****Site Address: Marcus Hook, PA****Field Personnel: Neil Laird**

Depth	Description	Symbol	Sampler Type	Blow Counts per 6 inches	Sample Depth
0	Ground Surface				
	Clayey Silt Fill Orange brown clayey silt w/ sand, some micas, aggregate.			5	
				8	
				9	
2				9	
				6	
	Hydrocarbon-like odor, some black staining present.			8	
				7	
4				6	
	Some gravel present, wet.			5	
				3	
				4	
6				4	
	Slightly more clayey.			4	
				4	
				4	
8	Shelby tube driven 7-10 ft.		ST		(7-9)
	Refusal @ 9 ft. 16 inches recovery. GT-1 located adjacent to MW-141 (MW-1).				
10					

Drilled By: M & R Soil Invest., Inc.

Start Date: March 13, 2000

Hole Size: 4 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 13, 2000

Sheet: 1 of 1



DAMES & MOORE

A DAWSON GROUP COMPANY

Borehole #: GT-2

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 21, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Sampler Type	Blow Counts per 6 inches	Sample Depth
0	Ground Surface				
	Silty Sand Fill Orange brown silty sand w/ clay and gravel, concrete fragments.			2	
				3	
				3	
2	Brick fragments			2	
				12	
				8	
				5	
4				3	
				3	
				2	
	Shelby tube driven 5-8 ft. 21 inches of recovery. GT-2 located east of MW-115.		ST		(5-8)
6					
8					
10					

Drilled By: M & R Soil Invest., Inc.

Start Date: March 13, 2000

Hole Size: 4 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 13, 2000

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR & HOBSON GROUP COMPANY

Borehole #: GT-3

Boring Location: Phillips Island

Project: Phase II

Client: FPLE/Sunoco

Date: March 21, 2000

Project No: 25995-046

Site Address: Marcus Hook, PA

Field Personnel: Neil Laird

Depth	Description	Symbol	Sampler Type	Blow Counts per 6 inches	Sample Depth
0	Ground Surface				
2	<i>Fill</i>				
4	<i>Clayey Silt Fill</i> Dark gray/brown clayey silt w/ sand and aggregate, some wood fragments. Aggregate amount increasing.			2 15 20 44 2 20 50 48 35 25 30 19	
6	Aggregate w/ sandy silt, some clay.				
8	Orange brown clayey silt w/ some gravel and sand.				
10	<i>Silty Clay Waste</i> Dark brown silty clay, moist to wet, very little recovery.			2 2 Hammer 6 4 2 3 4	
12	No recovery.				
14	Shelby tube driven 12-15 ft. 27 inches recovery. GT-3 located 20 ft. east of MW-143 (MW-8).		ST		(12-15)
16					
18					
20					

Drilled By: M & R Soil Invest., Inc.

Start Date: March 13, 2000

Hole Size: 4 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 13, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A TIAW S & MOORE GROUP COMPANY

Borehole #: GT-4**Boring Location: Phillips Island****Project: Phase II****Client: FPLE/Sunoco****Date: March 21, 2000****Project No: 25995-046****Site Address: Marcus Hook, PA****Field Personnel: Neil Laird**

Depth	Description	Symbol	Sampler Type	Blow Counts per 6 inches	Sample Depth
0	Ground Surface				
2	<i>Fill</i>				
4				8 10 13 10	
6					
8	Brown clayey silt w/ aggregate			8 12 10 20	
10					
12				3 3 4 6	
14	<i>Silty Clay Waste</i> Gray brown silty clay.				
16	Shelby tube driven 15-18 ft. GT-4 located adjacentg to MW-145 (MW-5).		ST		(15-18)
18					
20					

Drilled By: M & R Soil Invest., Inc.

Start Date: March 13, 2000

Hole Size: 4 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 13, 2000

Sheet: 1 of 1

**DAMES & MOORE**

A TAYLOR & HODGSON GROUP COMPANY

Borehole #: GT-5**Boring Location: Phillips Island****Project: Phase II****Client: FPLE/Sunoco****Date: March 21, 2000****Project No: 25995-046****Site Address: Marcus Hook, PA****Field Personnel: Neil Laird**

Depth	Description	Symbol	Sampler Type	Blow Counts per 6 inches	Sample Depth
0	Ground Surface				
2	<i>Fill</i>				
4				2-3 6-6	
6					
8					
10				2-4 5-7	
12	Clayey Silt Fill Dark brown clayey silt w/ gravel and some brick fragments, sand, and wood fragments, some black staining.			5-7 9-7	
14					
16					
18					
20				2-2 3-2	
22					
24	Silty Clay Waste Black stained silty clay, moist			1-2 2-3	
26					
28	Shelby tube driven 27-30 ft. 20 inches of recovery. GT-5 located adjacent to B-PH7.		ST		(27-30)
30					
32					
34					

Drilled By: M & R Soil Invest., Inc.

Start Date: March 13, 2000

Hole Size: 4 1/4 in.

Drill Method: Hollow Stem Auger

Finish Date: March 13, 2000

Sheet: 1 of 1



DAMES & MOORE

A TAYLOR S. & MOORE GROUP COMPANY

Piezometer #: 1-3

Boring Location: Phillips Island

Project: Act 2

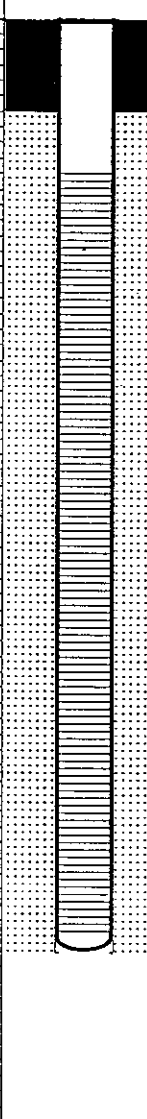
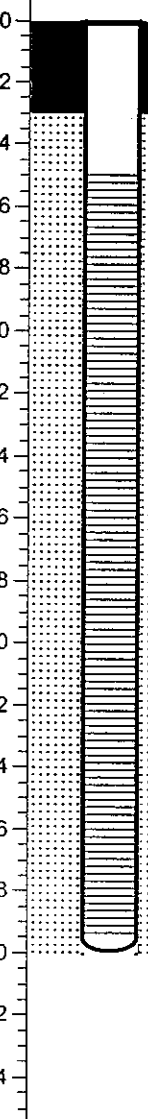
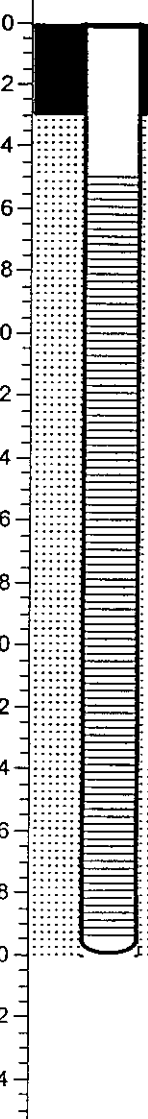
Client: FPLE/Sunoco

Date: April 4, 2000

Project No: 25995-047

Site Address: Marcus Hook, PA

Field Personnel: Shawn Miller

PZ-1		PZ-2		PZ-3		Remarks
Depth	Well Construction	Depth	Well Construction	Depth	Well Construction	
0		0		0		<p>All three piezometers were constructed with 2-inch schedule 40 PVC screen and riser with approximately two feet of stickup.</p> <p>4-inch schedule 40 PVC was placed over the 2-inch stickup to act as a protective casing.</p> <p>PZ-1 is located 6.00 feet from MW-115.</p> <p>PZ-2 is located 4.75 feet from MW-116.</p> <p>PZ-3 is located 5.58 feet from MW-117.</p>
2		2		2		
4		4		4		
6		6		6		
8		8		8		
10		10		10		
12		12		12		
14		14		14		
16		16		16		
18		18		18		
20		20		20		
22		22		22		
24		24		24		
26		26		26		
28		28		28		
30		30		30		
32		32		32		
34		34		34		

Start Date: March 24, 2000

Drilled By: Tri State Env. Mngmt. Services, Inc.

Hole Size: 6 1/4 in.

Finish Date: March 24, 2000

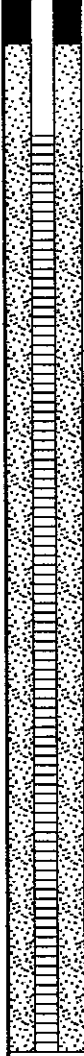
Drill Method: Hollow Stem Auger

Sheet: 1 of 1

SECOR

International Incorporated

Logged By: SM	Dates Drilled: 06/25/02 06/26/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Split Spoon	Well Number: MW-216
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam. (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
				Drive wt. (lbs.):	Drop Dist. (in.):

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
			SAND, fine to coarse AND SILT; little fine gravel, pieces of brick, brown, dry.	1.3	0.0
			SILT AND SAND, fine to coarse; little fine gravel, pieces of brick, brown, dry.		0.0
			SILT AND SAND, fine to coarse; little fine gravel, pieces of brick, brown, dry.	1.2	0.0
			BRICK		0.0
			SILT; some fine to coarse sand, some fine gravel, brown, dry.		0.0
			SILT; little fine to coarse sand, brown, dry.	0.4	0.0
	5		SILT; little fine to coarse sand, brown, dry.	1.2	
			SAND, coarse AND GRAVEL, fine; trace fine to coarse sand, black, moist, oil.	1.8	
			SILT AND SAND, fine to coarse; trace fine gravel, black, moist, oil.		
	10		CLAY; some fine to coarse sand, little silt, brown/gray, dry.		
			CLAY; some silt, little fine to medium sand, gray, moist, oil.	1.0	
			CLAY AND SILT; little fine to coarse sand, trace fine gravel, gray, moist, oil.	1.1	
	15		CLAY; some silt, little fine to medium sand, gray, moist.	1.3	
			SILT; some clay, little fine to medium sand, black, dry.		
			CLAY; some silt, little fine to medium sand, brown/gray, moist.	1.8	
			SILT; some clay, trace fine to medium sand, black, dry.		
			SILT; some clay, little fine to medium sand, trace coarse sand, black, moist.	1.1	
	20		CLAY; some silt, little fine to medium sand, trace coarse sand, black, moist.	1.3	
		CLAY; some silt, little fine to medium sand, trace coarse sand, black, moist.	1.0		
		SILT; some clay, little fine to medium sand, black, moist.			
		SILT AND CLAY; trace fine to coarse sand, black, moist.	0.9		

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

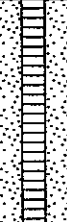
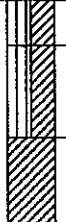
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: SM	Dates Drilled: 06/25/02 06/26/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Split Spoon	Well Number: MW-216
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam. (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
				Drive wt. (lbs.):	Drop Dist. (in.):
Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
	30		SILT AND CLAY; trace fine to coarse sand, black, moist.	1.0	
			CLAY; trace fine sand, black, moist.	1.4	
	35				
	40				
	45				

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date June 2002

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

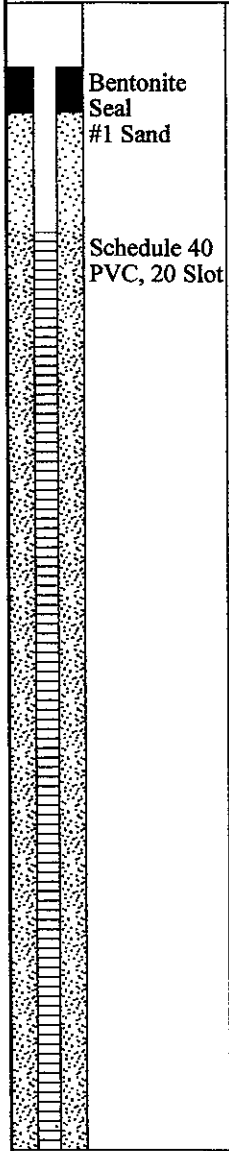
Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/27/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Cuttings		Well Number: MW-217
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):

Well Construction	Depth, (ft.)	Sample Type	Description
			SAND, fine to coarse; some silt, little fine gravel, pieces of brick, brown, dry.
			SILT; some clay, little fine gravel, little fine to coarse sand, dark brown, dry.
	5		CLAY; little silt, little fine to coarse sand, black, moist.
			GRAVEL, fine AND SAND, coarse; trace silt, trace fine to medium sand, black, moist.
	10		CLAY; little silt, little fine to medium sand, gray/brown, moist.
	15		CLAY; trace fine to coarse sand, trace silt, gray, moist, oil.
	20		SILT; little fine to coarse sand, little clay, gray, moist.
			CLAY; little fine to coarse sand, little silt, black, moist, oil from 17 feet to approximately 22 feet.

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

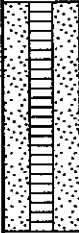

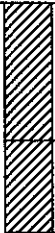
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/27/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Cuttings		Well Number: MW-217
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description				
			CLAY; trace fine sand, black, moist.				
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>							

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/26/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Cuttings	Well Number: MW-218
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam. (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
					Drive wt. (lbs.):
					Drop Dist. (in.):

Well Construction	Depth, (ft.)	Sample Type	Description
			SAND, fine to coarse AND SILT; little fine gravel, pieces of brick, brown, dry.
			CLAY AND SILT; little fine to coarse sand, brown, dry.
			SILT; little clay, little fine to coarse sand, black, dry.
	5		SILT; little clay, little fine to coarse sand, trace fine gravel, black, dry.
	10		CLAY; some silt, little fine to coarse sand, gray, moist, oil at approximately 12 feet.
	15		SILT AND CLAY; little fine to coarse sand, black, moist.
	20		SILT; some clay, little fine to coarse sand, black, moist, plastic present at approximately 21 feet.

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

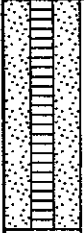

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/26/02	Drilling Contractor: Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Cuttings		Well Number: MW-218	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					
								
			CLAY; little silt, trace fine sand, black, moist.					
	30							
	35							
	40							
	45							
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

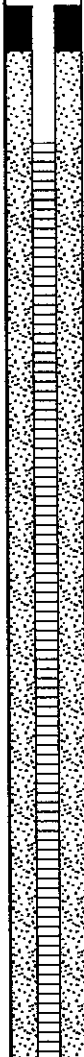
Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/26/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-219	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam. (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt. (lbs.):	Drop Dist. (in.):	

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
			SILT; some fine to coarse sand, trace fine gravel, brown, dry.	1.0	7.1
			SILT; some fine to coarse sand, trace fine gravel, piece of brick, brown, dry.	0.8	5.3
			SILT; some fine to coarse sand, little clay, gray, moist.		25.6
			SILT; little fine to coarse sand, little clay, pieces of brick, black, dry.	0.6	22.9
	5		SILT; little fine to coarse sand, little clay, black, dry.	1.4	5.5
			SILT; some clay, little fine to coarse sand, gray, dry.		13.8
			SAND, fine to coarse AND SILT; gray, dry.		22.1
			NO RECOVERY - stone in shoe of spoon.	0.0	
	10		CLAY; some silt, little fine to medium sand, piece of wood, gray/brown, moist.	0.3	25.8
			CLAY AND SILT; little fine to coarse sand, brown, moist, oil.	1.3	14.4
			SILT; some fine to medium sand, little clay, gray/black, moist.		20.0
			SILT; little fine to coarse sand, little clay, gray, moist.	0.2	5.3
	15		SILT; some clay, little fine to medium sand, piece of wood, gray/brown, moist.	1.1	13.0
			SILT; some clay, little fine to medium sand, gray/brown, moist.	1.1	0.0
			SILT; some fine to medium sand, black, dry.		7.4
	20		CLAY; little silt, little fine to coarse sand, pieces of brick and wood, brown, moist.	1.4	3.1
			SILT; little clay, little fine to medium sand, black, moist.		6.1
			CLAY; trace silt, trace fine sand, black, moist.	0.6	25.0
			CLAY; little fine sand, trace silt, black, moist.		16.5
			CLAY; little fine sand, trace silt, black, moist.	1.3	17.6

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

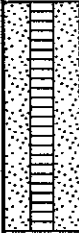



PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/26/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-219		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					Recovery	PID Reading (ppm)
	30		CLAY; little fine sand, trace silt, black, moist.					2.0	34.1
			CLAY; little fine sand, trace silt, black, moist.					2.0	23.0
	35								
	40								
	45								
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>									

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

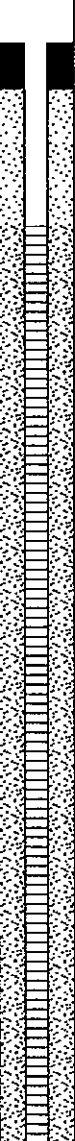
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/27/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-220	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam. (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt. (lbs.):	Drop Dist. (in.):
Well Construction	Depth, (ft.)	Sample Type	Description				Recovery	PID Reading (ppm)
			SILT; little fine to coarse sand, trace clay, trace fine gravel, brown, dry.				1.1	0.0
			CLAY; some silt, little fine to coarse sand, brown, dry.				1.2	0.0
			CLAY; some silt, little fine to coarse sand, little silt, brown, dry.					5.0
			SAND, fine to coarse; little silt, gray, dry.				0.6	0.0
			SAND, fine to coarse; little silt, little fine gravel, gray, dry.					0.0
	5		CLAY; little silt, little fine to coarse sand, brown/gray, moist.				0.7	0.0
			CLAY; little fine to medium sand, little silt, trace coarse sand, brown/gray, moist.				0.5	6.0
	10		CLAY; some silt, little fine sand, gray, moist. Piece of fine gravel in shoe of spoon.				0.3	5.3
			CLAY; some silt, little fine sand, gray, moist.				0.5	0.0
	15		CLAY; little fine sand, some silt, black, moist.				0.5	8.0
			CLAY AND SILT; trace fine to coarse sand, black, moist.				0.6	21.0
			CLAY AND SILT; trace fine to coarse sand, black, moist.				1.0	9.7
	20		SAND, fine to medium; orange brown, moist.				0.9	7.6
			CLAY AND SILT; trace fine to coarse sand, black, moist.					5.0
		SILT; little clay, little fine to medium sand, black, moist.				9.6		
		SILT; some clay, trace fine to coarse sand, black, moist.				0.8	22.5	
		SILT; little fine to coarse sand, black, moist, oil.				0.1	25.1	

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

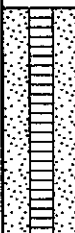

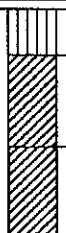
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: SM	Date Drilled: 06/27/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-220		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					Recovery	PID Reading (ppm)
			Piece of rock in shoe of spoon.					0.5	8.4
			CLAY; some silt, trace fine to coarse sand, gray, moist.						
			CLAY; some silt, little fine to coarse sand, black, moist.						
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>									

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

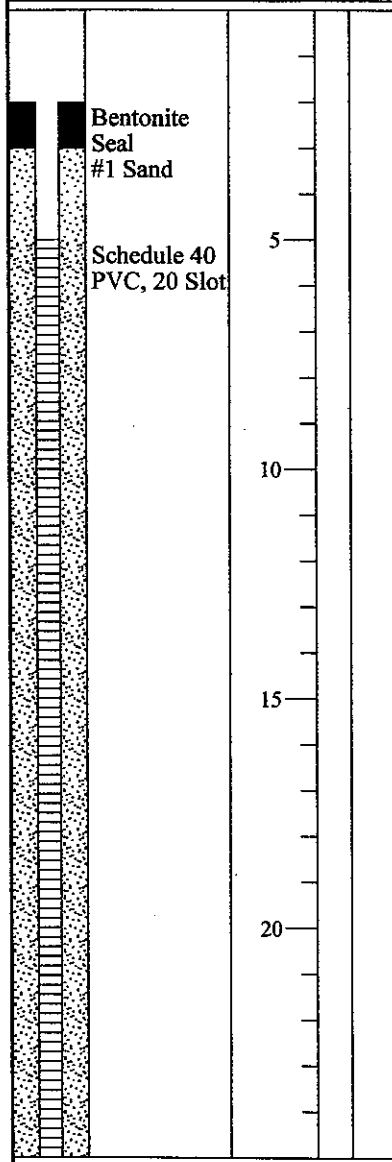
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/23/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Cuttings	Well Number: MW-221
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
				Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description		
 <p>Bentonite Seal</p> <p>#1 Sand</p> <p>Schedule 40 PVC, 20 Slot</p> <p>5</p> <p>10</p> <p>15</p> <p>20</p>					
LITHOLOGY SIMILAR TO ADJACENT WELL, MW-219					
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>					

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

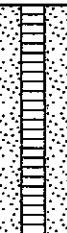
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/23/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Cuttings		Well Number: MW-221	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description					
	30		Bottom Plug					
	35							
	40							
	45							
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

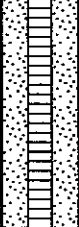
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/23/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Cuttings		Well Number: MW-222	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam (in.): 4	Surface Elev. (ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt. (lbs.):	Drop Dist. (in.):
Well Construction	Depth, (ft.)	Sample Type	Description					
	30		Bottom Plug					
	35							
	40							
	45							
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

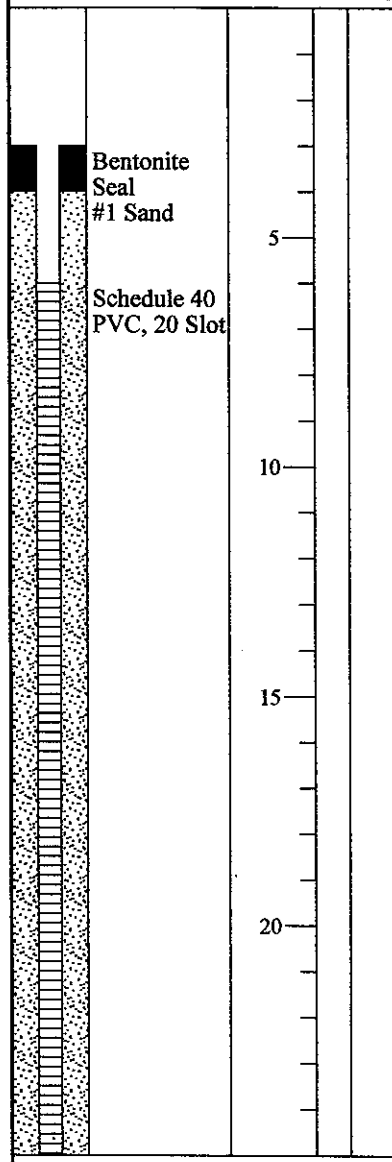
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/24/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Cuttings	Well Number: MW-223
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 26.0
Drive wt.(lbs.):		Drop Dist.(in.):			
Well Construction	Depth, (ft.)	Sample Type	Description		
 <p>Bentonite Seal #1 Sand Schedule 40 PVC, 20 Slot</p> <p>LITHOLOGY SIMILAR TO ADJACENT WELL, MW-226</p>					
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>					

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well


PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/24/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Cuttings	Well Number: MW-223
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 26.0
				Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description		
	Bottom Plug				
	30				
	35				
	40				
	45				
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>					

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

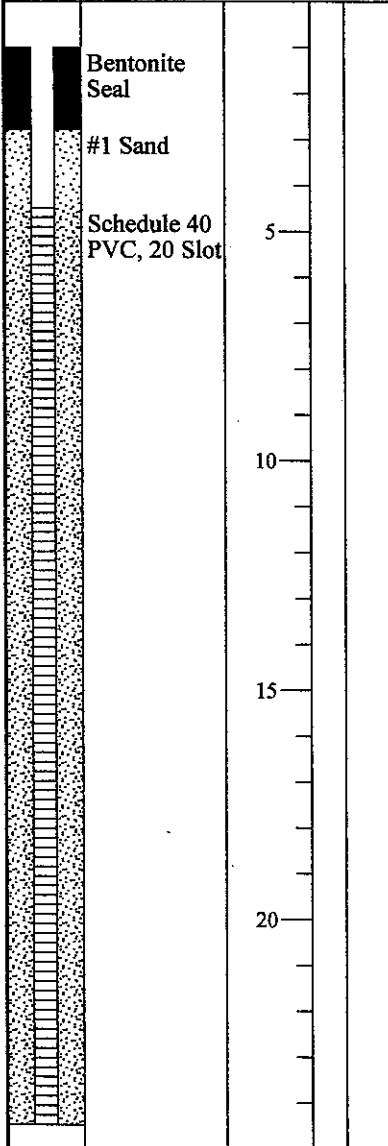
Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/23/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Cuttings	Well Number: MW-224
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 24.5
		Drive wt.(lbs.):	Drop Dist.(in.):		

Well Construction	Depth, (ft.)	Sample Type	Description
			LITHOLOGY SIMILAR TO ADJACENT WELL, MW-225

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/24/02	Drilling Contractor: Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Split Spoon	Well Number: MW-225
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 6	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
					Drive wt.(lbs.):
					Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
			FILL; silt and gravel, some fine to medium sand, brown, dry.	1.0	16.1
			FILL; silt and gravel, some fine to medium sand, brown, dry.	1.7	15.5
			FILL; silt and gravel, some fine to medium sand, brown, dry.	1.3	11.4
			FILL; silt and gravel, some fine to medium sand, brown, dry.	1.7	16.9
			FILL; silt and gravel, some fine to medium sand, brown, dry.	1.3	14.5
	5		SILT; little fine sand, gray with some orange-brown spotting, dry.		10.2
			STONE	0.4	7.4
			SILT; some fine to medium sand, some gravel, trace clay, greenish-gray/brown, dry.		7.4
			SAND, fine to medium AND SILT; little gravel, brown, dry.	2.0	10.5
			SILT; some fine sand, trace clay, greenish-gray, dry.		88.9
			SILT; little fine to medium sand, little clay, grayish-brown, little moisture, slight odor. PID reading of 88.9 ppm from 13.8 to 14 feet.	2.0	146
	15		SILT; some fine to medium sand, some gravel, some clay, greenish-gray/grayish-brown/brown, moist, odor.		
			SILT; little clay, dark gray/black, moist, odor. One 0.1 foot black cobble piece within recovery.	1.3	83.6
			SILT AND CLAY; black, dry.		54.7
			SAND, fine AND SILT; some medium sand, trace gravel, dark brown, dry, tight.	2.0	77.8
			SILT AND SAND, fine to medium; black, dry.		47.6
			SILT; little clay, black, moist, odor.		47.6
	20		SILT; little gravel, little fine sand, little clay, grayish-brown, moist, odor.		49.8
			SAND, fine to medium AND SILT; some coarse sand, grayish-brown, moist, odor.	0.8	48.6
			SILT; some clay, little gravel, little fine sand, black, moist, odor.		42.0
		SILT; some fine to medium sand, some gravel, some clay, gray, moist, odor.	2.0	30.1	
		SILT; some clay, some fine sand, little medium sand, gray with pinkish specks, little product observed. Clay lens at 23.5 to 23.54 feet, 23.67 to 23.70 feet and 23.75 to 23.79 feet.			
		SILT; some fine sand, some clay, little medium sand, gray with pinkish specks,	2.0	36.6	

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date June 2002

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/24/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-225		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 6	Surface Elev.(ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					Recovery	PID Reading (ppm)
	30 35 40 45		wet, product.					2.0	36.6 36.3
			CLAY; plastic between stratigraphic layers, dark gray, product. CLAY; gray, product. Plastic at 27.7 feet.						
			CLAY; trace fine sand, gray, product.						
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>									

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

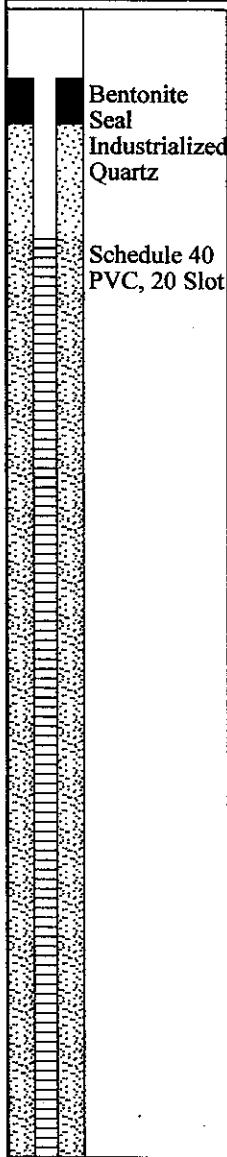
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Dates Drilled: 07/24/02 07/25/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-226	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 6	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description				Recovery	PID Reading (ppm)
			FILL; silt and gravel, some fine to medium sand, brown, dry.				0.8	12.2
			FILL; silt, some gravel, some fine to medium sand, brown, dry.				0.7	9.5
	5		FILL; silt and gravel, some fine to medium sand, brown, moist.				1.5	148
			NO RECOVERY				0	
			SILT AND CLAY; some fine to medium sand, some gravel, grayish-brown, moist, odor.				1.0	16
	10		SILT AND CLAY; little gravel, little fine to medium sand, grayish-brown, moist, odor.				2.0	12.4
			SILT AND CLAY; some fine to medium sand, little gravel, grayish-brown/greenish-brown/brown/dark brown, moist to wet, odor.				2.0	5.3
	15		SILT AND CLAY; some fine to medium sand, little gravel, grayish-brown/greenish-brown/brown/dark brown, moist to wet, odor.				2.0	6.4
			SAND, fine to medium AND SILT; little gravel, dark brown/black, dry.				2.0	50.1
			SILT; some fine sand, little clay, trace sand, trace gravel, gray-brown, moist, odor.					8.6
			SILT; some fine sand, little clay, trace sand, trace gravel, blackish-brown, moist, odor.					8.6
			SILT; some fine sand, little clay, trace sand, trace gravel, blackish-brown, moist, odor.				0.8	9.2
			SILT; some fine sand, some clay, little medium sand, gray with pink specks, moist, odor.					8.7
			SILT; some fine sand, some clay, little medium sand, gray with pink specks, moist, odor.					8.4
	20		SILT; little fine sand, little clay, gray-brown/light brown, moist, odor.				1.2	9.7
			SILT; some clay, little fine to medium sand, little gravel, brown, dry.					
			SAND, fine to medium AND SILT; little clay, little gravel, brown, wet, heavy product thickness at 21.5 feet.					
			SAND, fine to coarse; some silt, brown with whitish specks, wet.				1.2	12.2
			SILT; some fine to medium sand, little sand, dark brown, wet, product.					70.4
			SILT; some fine sand, little clay, trace gravel, dark gray, wet.				1.0	39.6

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date June 2002

Log of Well

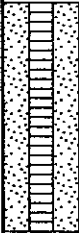

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Dates Drilled: 07/24/02 07/25/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-226		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 6	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):		
Well Construction	Depth, (ft.)	Sample Type	Description					Recovery	PID Reading (ppm)
	30		SILT; some fine to medium sand, little clay, trace gravel, dark gray, wet.					1.7	21.6
			SILT; some fine to medium sand, little clay, trace gravel, dark gray, wet.					1.3	30.4
			SILT AND SAND, fine to medium; some gravel, trace clay, gray, wet.						30.4
	35								
	40								
	45								

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. **62SU.01009.02**

Date **June 2002**

Log of Well

PHILIPS ISLAND GPI
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/10/02	Drilling Contractor: Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Split Spoon	Well Number: MW-245
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
					Drive wt.(lbs.):
					Drop Dist.(in.):

Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
			SILT; some gravel/rock fragments, little fine to medium sand, dark brown, moist.	1.1	0.0
			SILT AND SAND, fine; some gravel, light brown, dry.	0.6	0.0
			WOOD FRAGMENT	2.0	0.0
	5		SILT; some gravel/rock fragment, some fine sand, dark brown, moist, plastic sheeting at 5.6'.		
			SILT AND GRAVEL/rock fragment; some brick fragments, some fine to medium sand, brown, moist.	2.0	0.0
			SILT; some fine to medium sand, little gravel, trace clay, dark brown, dry, petroleum hydrocarbon odor.		
			SILT AND SAND, fine; brown, little rock and brick fragments, moist.	2.0	0.0
			SAND, fine to medium AND SILT.		0.0
	10		SILT; little gravel, little fine to medium sand, trace clay, dark brown, moist, slight petroleum hydrocarbon odor.	1.6	0.0
			SILT; some gravel/rock fragments, some fine to medium sand, trace clay, brown, moist, slight petroleum hydrocarbon odor.		
			SILT, brown AND CLAY, gray; little fine to medium sand, moist.	1.8	0.0
			ROCK FRAGMENTS.		0.0
			SILT; some clay, little fine to medium sand, dark brown, moist, petroleum hydrocarbon odor.		
	15		SILT AND SAND, fine to coarse; brown, moist, petroleum hydrocarbon odor.	2.0	0.0
			SAND, fine to medium AND SILT, black, tar-like, moist, petroleum hydrocarbon odor.		0.0
			SAND, fine to medium; some silt, brown, moist, presence of free product.	0.8	0.0
			SILT AND CLAY; little fine sand, brownish gray, wet, petroleum hydrocarbon odor.		0.0
			SILT AND CLAY; little fine sand, gray, wet, presence of free product.	0.6	0.0
			SILT AND CLAY; gray, wet, presence of free product.		
	20		SILT; little clay, little fine to medium sand, wet, presence of free product	1.0	0.0
		SILT AND CLAY; gray, wet, presence of free product.	2.0	0.0	
		SAND, fine to medium AND SILT; brown, wet, presence of free product, white, fibrous, silty material along side of spoon from 22.6-22.9.		0.0	
		SILT AND CLAY; little gravel, gray, wet, presence of free product.		0.0	
		SILT AND CLAY; little fine to coarse sand, little gravel, wet, petroleum	2.0	0.0	

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 2002

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 07/10/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-245	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description				Recovery	PID Reading (ppm)
			hydrocarbon odor.					
			ROCK FRAGMENT stuck in tip of spoon, very little recovery.				0.1	0.0
			SILT and SAND, fine to medium; little clay, little gravel, grayish brown, wet, petroleum hydrocarbon odor.				0.9	0.0
			* PID was calibrated several times and properly reading calibration gas but sample readings did not validate olfactory observations.					
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. 62SU.01009.02

Date 2002

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 08/10/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA	Method/Equipment: Hollow Stem Auger Split Spoon	Well Number: MW-246
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
				Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description	Recovery	PID Reading (ppm)
			SILT; some fine to coarse sand, little gravel, brown, dry.	0.7	0.0
			SILT AND SAND, fine to medium; little gravel, brown, dry. Rock stuck in tip of spoon.	0.2	0.0
			SILT; little fine to medium sand, little gravel, brown, dry, brick fragments.	0.8	0.0
	5		SILT; some fine to medium sand, little clay, gray, greenish gray and brown mottled, dry.	2.0	11.5
			SILT; some fine to medium sand, little gravel, trace clay, dark brown, dry, petroleum hydrocarbon odor.		30.0
			SILT; some fine to medium sand, little gravel, brown, dry, petroleum hydrocarbon odor.	1.8	
	10		SILT; some fine to medium sand, trace gravel, trace clay, moist, strong petroleum hydrocarbon odor.		116
			SILT AND SAND, fine; little gravel/rock fragment, moist, petroleum hydrocarbon odor.	0.4	
			SAND, fine to medium AND SILT; little gravel, little clay, moist, petroleum hydrocarbon odor.	0.5	
	15		SAND, fine to medium AND SILT; some coarse sand, some gravel, little clay, wet, presence of free product.	1.4	
			SAND, fine to medium AND SILT; some coarse sand, some gravel, little clay, wet, presence of free product.	1.0	
			SAND, fine to coarse; some silt; little clay, brown, wet, presence of free product.	1.7	
	20		SILT AND CLAY; some fine to medium sand, some gravel, dark gray, wet, presence of free product, newspaper pieces. Gravel layer at 19.1-19.2 and clay layer at 19.5-19.6.	1.0	35.8
			SILT AND CLAY; some gravel, little fine to medium sand, presence of free product.		
			SILT AND CLAY; some fine to medium sand, little gravel, wet, presence of free product.	2.0	213
		SILT AND CLAY; some fine to medium sand, some gravel, gray, wet, presence	1.1	269	

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 2002

Log of Well

PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 08/10/02	Drilling Contractor Parratt-Wolff, Inc.	Project Name: Sunoco, Inc. Marcus Hook Refinery, PA		Method/Equipment: Hollow Stem Auger Split Spoon		Well Number: MW-246		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 4	Surface Elev.(ft.):	Groundwater Depth (ft.):		Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					Recovery	PID Reading (ppm)
			of free product.						
			SAND, fine to coarse; some silt, wet, presence of free product.					1.4	233
			SILT AND SAND, fine to medium; some gravel, little clay, wet, presence of free product.						
			SILT; some fine to medium sand, some clay, trace gravel, gray, wet, presence of free product.					1.5	89.5
	30		ROCK FRAGMENT; petroleum hydrocarbon staining on bottom of rock.						
			SILT; some fine to medium sand, some clay, trace gravel, gray, wet, presence of free product.						
	35								
	40								
	45								

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 2002

Log of Well

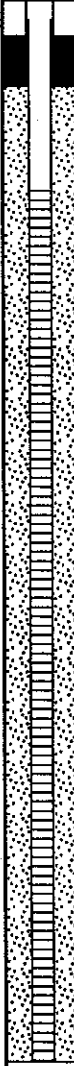
PHILIPS ISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 2 of 2)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 10/20/03	Drilling Contractor: B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania	Method/Equipment: Hollow Stem Auger	Well Number: MW-256		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.6	Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description			PTD Reading (ppm)	
			Light brown-grayish brown SAND, fine to medium, some silt and gravel.				
	4.1		Dark brown SILT, some fine to medium sand, little gravel, oily. A few pieces of plastic sheeting stained by oil coming up in the cuttings.				
	12.8		Dark brown-black SILT, little fine to medium sand, little clay, wet/oily.				
	41.2		Log developed from drill cuttings.				

NOTE: Likely large voids in well column from gravel or rubble, had to use significantly more sand to set well.

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Dates Drilled: 10/20/03 10/21/03	Drilling Contractor B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania	Method/Equipment: Hollow Stem Auger	Well Number: MW-257
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0
					Drive wt.(lbs.):
					Drop Dist.(in.):

Well Construction	Depth, (ft.)	Sample Type	Description	PID Reading (ppm)
			Brown SILT , some fine to medium sand, little gravel, trace clay.	0.8
			Brown SILT , some fine to medium sand, little gravel and clay.	4.5
	5			
	10		Black SILT , some clay and fine to medium sand.	10.8
	15			
	20		Black SILT , some clay, little fine sand, wet.	18.3
	25		Dark gray CLAY , some silt.	28.2
	30		Log developed from drill cuttings.	46.2

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

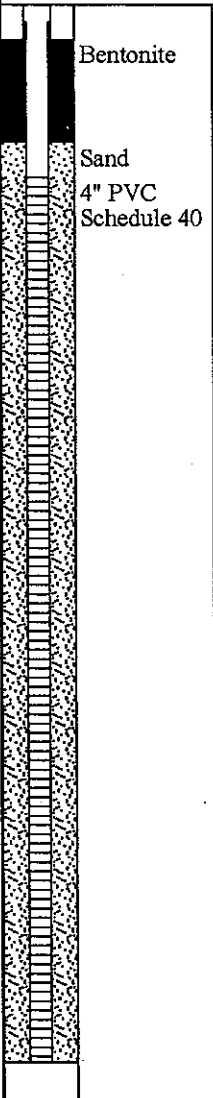
PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 10/20/03	Drilling Contractor: B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania		Method/Equipment: Hollow Stem Auger		Well Number: MW-258	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.4	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					PID Reading (ppm)
			Brown-dark brown SILT and fine to medium sand, some gravel.					
	5							
	10.2		Dark brown-black SILT , little fine to medium sand, trace gravel, oily/wet.					10.2
	17.8		Gray CLAY , some silt, wet/oily.					17.8
	15							
	20							
	25							
	30							
			Log developed from drill cuttings.					35.4
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 10/21/03	Drilling Contractor: B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania		Method/Equipment: Hollow Stem Auger		Well Number: MW-259	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.3	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					PID Reading (ppm)
			Gray SILT.					
			Gray, fine to medium SAND, some silt.					
	5							
	10		Gray CLAY, some fine to medium sand and silt.					4.2
	15							
	20		Gray CLAY, little silt, oily.					
	25							
	30							
			Log developed from drill cuttings.					47.0

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

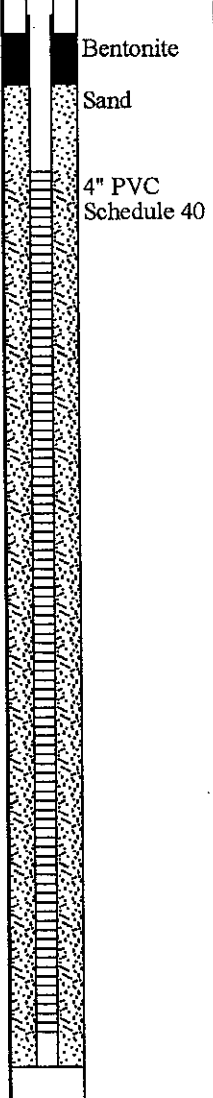
PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 10/21/03	Drilling Contractor: B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania		Method/Equipment: Hollow Stem Auger		Well Number: MW-260	
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.8	Drive wt.(lbs.):	Drop Dist.(in.):	
Well Construction	Depth, (ft.)	Sample Type	Description					PID Reading (ppm)
	5		Brown and black SILT , some fine to medium sand, trace clay.					
	10		Black SILT , some fine to medium sand, little clay. Dark gray CLAY , little silt, oily.					0.2
	20		Dark gray CLAY , little silt.					11.6
	30		Log developed from drill cuttings.					1.8
<p>The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.</p>								

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

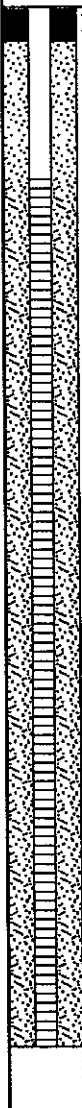
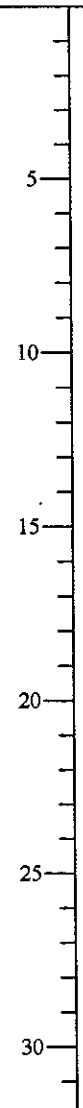

PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

SECOR

International Incorporated

Logged By: CY	Date Drilled: 10/21/03	Drilling Contractor: B.L. Myers	Project Name: Philips Island Marcus Hook, Pennsylvania	Method/Equipment: Hollow Stem Auger	Well Number: MW-261		
See "Legend to Logs" for sampling method, classifications and laboratory testing methods		Boring Diam.(in.): 8	Surface Elev.(ft.):	Groundwater Depth (ft.):	Total Depth (ft.): 30.0	Drive wt.(lbs.):	Drop Dist.(in.):
Well Construction	Depth, (ft.)	Sample Type	Description			PID Reading (ppm)	
			Brown/tan, fine to medium SAND and SILT.				
			Gray SILT, some brown, fine to medium sand, some clay patches.				
			Black SILT, some clay and fine to medium sand.			8.4	
			Gray CLAY, little silt, trace fine to medium sand.			21.7	
	30		Log developed from drill cuttings.			4.5	

The substrata descriptions above are generalized representations and based upon visual/manual classification of cuttings and/or samples obtained during drilling. Predominant material types shown on the log may contain different materials and the change from one predominant material type to another could be different than indicated. Descriptions on this log apply only at the specific location at the time of drilling and may not be representative of subsurface conditions at other locations or times.

Project No. 62SU.01009.02

Date 03/19/2004

Log of Well

PHILIPSISLAND.GPJ
LOG OF BOREHOLE

Figure

(sheet 1 of 1)

Appendix D
Fate & Transport Model Results First Run

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION																																																																																						
Project: FPLE/SSunoco		Prepared by: Neil Laird																																																																																				
Date: 03/14/2000		Contaminant: Benzene-MW-118																																																																																				
X																																																																																						
SOURCE CONC (MG/L)	0.05	DISTANCE T/Ax LOCATION q (ft)	11	Ay (ft)	1.1	Az (ft)	0.11	LAMBDA day-1	0.001	SOURCE WIDTH (ft)	100	SOURCE THICKNESS (ft)	20																																																																									
Hydraulic Cond (ft/day)	5.63E-01	Hydraulic Gradient (ft/ft)	0.0048	Porosity (dec. frac.)	0.3	Soil Bulk Density (g/cm ³)	1.7	Frac. Org. Carb.	58	Retard-ation (R)	2.64333333	V (=K [*] i/n [*] R)	0.00341024																																																																									
<div style="display: flex; justify-content: space-between;"> <div> <p>PA DEPARTMENT OF ENVIRONMENTAL PROTECTION</p> <p>QUICK_DOMENICO.XLS</p> <p>SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"</p> <p>P.A. Domenico (1987)</p> <p>Modified to Include Retardation</p> </div> </div>																																																																																						
Projected Conc. at 10950 days																																																																																						
at 0.004 mg/l		<div style="display: flex; justify-content: space-between;"> <div> <p>AREAL MODEL</p> <p>Length (ft) 10</p> <p>Width (ft) 250</p> </div> <div> <p>CALCULATION DOMAIN</p> <p>Length (ft) 10</p> <p>Width (ft) 250</p> </div> </div>																																																																																				
250		<table border="1"> <thead> <tr> <th>Distance (ft)</th> <th>0</th> <th>1</th> <th>2</th> <th>3</th> <th>4</th> <th>5</th> <th>6</th> <th>7</th> <th>8</th> <th>9</th> <th>10</th> </tr> </thead> <tbody> <tr> <td>250</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>125</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>0</td> <td>0.040</td> <td>0.032</td> <td>0.025</td> <td>0.020</td> <td>0.016</td> <td>0.013</td> <td>0.010</td> <td>0.008</td> <td>0.007</td> <td>0.005</td> <td>0.005</td> </tr> <tr> <td>-125</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> <tr> <td>-250</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> <td>0.000</td> </tr> </tbody> </table>													Distance (ft)	0	1	2	3	4	5	6	7	8	9	10	250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0.040	0.032	0.025	0.020	0.016	0.013	0.010	0.008	0.007	0.005	0.005	-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Distance (ft)	0	1	2	3	4	5	6	7	8	9	10																																																																											
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																											
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																											
0	0.040	0.032	0.025	0.020	0.016	0.013	0.010	0.008	0.007	0.005	0.005																																																																											
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																											
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000																																																																											

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
Project: FPLE/Ssunoco		Prepared by: Neil Laird												
Date: 03/14/2000		Contaminant: Benzene-MW-118												
X														
SOURCE CONC (MG/L)	0.05	DISTANCE T Ax (ft)	50	Ay (ft)	5	Az (ft)	0.5	LAMBDA day-1	0.000959	SOURCE WIDTH (ft)	100	SOURCE THICKNESS (ft)	20	
Hydraulic Cond (ft/day)	2.61E+00	Hydraulic Gradient (ft/ft)	0.0048	Porosity (dec. frac.)	0.3	Soil Bulk Density (g/cm ³)	1.7	Frac. Org. Carb. (R)	5.00E-03	Retard- ation (R)	2.64333333	V (=K'/in*R) (ft/day)	0.01580429	
y(ft)		z(ft)		Time (days)										
50		0		0		10950								
Projected Conc. at 10950 days														
at 0.004 mg/l														
AREAL CALCULATION MODEL DOMAIN														
Length (ft)		Width (ft)												
250		6												
125		12												
0		250												
-125		18												
-250		24												
		30												
		36												
		42												
		48												
		54												
		60												
		66												
		72												
		78												
		84												
		90												
		96												
		102												
		108												
		114												
		120												
		126												
		132												
		138												
		144												
		150												
		156												
		162												
		168												
		174												
		180												
		186												
		192												
		198												
		204												
		210												
		216												
		222												
		228												
		234												
		240												
		246												
		252												
		258												
		264												
		270												
		276												
		282												
		288												
		294												
		300												
		306												
		312												
		318												
		324												
		330												
		336												
		342												
		348												
		354												
		360												
		366												
		372												
		378												
		384												
		390												
		396												
		402												
		408												
		414												
		420												
		426												
		432												
		438												
		444												
		450												
		456												
		462												
		468												
		474												
		480												
		486												
		492												
		498												
		504												
		510												
		516												
		522												
		528												
		534												
		540												
		546												
		552												
		558												
		564												
		570												
		576												
		582												
		588												
		594												
		600												
		606												
		612												
		618												
		624												
		630												
		636												
		642												
		648												
		654												
		660												
		666												
		672												
		678												
		684												
		690												
		696												
		702												
		708												
		714												
		720												
		726												
		732												
		738												
		744												
		750												
		756												
		762												
		768												
		774												
		780												
		786												
		792												
		798												
		804												
		810												
		816												
		822												
		828												
		834												
		840												
		846												
		852												
		858												
		864												
		870												
		876												
		882												
		888												
		894												
		900												
		906												
		912												
		918												
		924												
		930												
		936												
		942												
		948												
		954												
		960												
		966												
		972												
		978												
		984												
		990												
		996												
		1002												
		1008												
		1014												
		1020												
		1026												
		1032												
		1038												
		1044												
		1050												
		1056												
		1062												
		1068												
		1074												
		1080												
		1086												
		1092												
		1098												
		1104												
		1110												
		1116												
		1122												
		1128												
		1134												
		1140												
		1146												
		1152												
		1158												
		1164												
		1170												
		1176												
		1182												
		1188												
		1194												
		1200												
		1206												
		1212												
		1218												
		1224												
		1230												
		1236												
		1242												
		1248												
		1254												
		1260												
		1266												
		1272												
		1278												
		1284												
		1290												
		1296												
		1302												
		1308												
		1314												
		1320												
		1326												
		1332												
		1338												
		1344												
		1350												
		1356												
		1362												
		1368												
		1374												
		1380												
		1386												
		1392												
		1398												
		1404												
		1410												
		1416												
		1422												
		1428												
		1434												
		1440												
		1446												
		1452												
		1458												
		1464												
		1470												
		1476												
		1482												
		1488												
		1494												
		1500												
		1506												
		1512												
		1518												
		1524												
		1530												
		1536												
		1542												
		1548												
		1554												
		1560												
		1566												
		1572												
		1578												
		1584												
		1590												
		1596												
		1602												
		1608												
		1614												
		1620												
		1626												
		1632												
		1638												
		1644												
		1650												
		1656												
		1662												
		1668												
		1674												
		1680												
		1686												
		1692												
		1698												
		1704												
		1710												
		1716												
		1722												
		1728												
		1734												
		1740												
		1746												
		1752												
		1758												
		1764												
		1770												
		1776												
		1782												
		1788												
		1794												
		1800												
		1806												
		1812												
		1818												
		1824												
		1830												
		1836												
		1842												
		1848												
		1854												
		1860												
		1866												
		1872												
		1878												
		1884												
		1890												

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
Project: FP/LE/Sunoco		Prepared by: Neil Laird												
Date: 03/14/2000		Contaminant: Dichloromethane-MW-137												
X														
SOURCE CONC (MG/L)	DISTANCE T Ax LOCATION Q (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)									
0.02	19	1.9	0.001	0.0123	100									
Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm ³)	KOC	Frac. Org. Carb. (R)	Retard- ation (ft/day)								
2.61E+00	0.0225	0.3	1.7	16	5.00E-03	1.45333333	0.13474197							
y(ft)		z(ft)		Time (days)										
19		0		0		10950								
Projected Conc. at 10950 days		19		0		0								
at 0.004 mg/l														
AREAL CALCULATION														
MODEL DOMAIN														
Length (ft) 30														
Width (ft) 250														
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.016	0.012	0.010	0.008	0.006	0.005	0.004	0.003	0.002	0.002	0.000	0.000	0.000	0.000
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 QUICK_DOMENICO.XLS
 SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
 P. A. Domenico (1987)
 Modified to Include Retardation

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION													
Project: FPLE/Ssunoco		Prepared by: Neil Laird											
Date: 03/14/2000		Contaminant: Benzene-MW-141											
X													
SOURCE CONC (MG/L)	0.006	DISTANCE T Ax LOCATION Q (ft)	0.1	Ay (ft)	0.01	Az (ft)	0.001	LAMBDA day-1	0.000959	SOURCE WIDTH (ft)	100	SOURCE THICKNESS (ft)	20
Hydraulic Cond (ft/day)	1.10E-02	Hydraulic Gradient (ft/ft)	0.0225	Porosity (dec. frac.)	0.3	Soil Bulk Density (g/cm ³)	1.7	KOC	58	Frac. Org. Carb. (R)	5.00E-03	Retardation (=K*/(1+R))	0.00031296
Projected Conc. at 10950 days		y(ft)		z(ft)		Time (days)							
at 0.004 mg/l		0.1		0		0 10950							
<div style="display: flex; justify-content: space-between;"> <div> <p>AREAL MODEL</p> <p>Length (ft) 1</p> <p>Width (ft) 250</p> </div> <div> <p>CALCULATION DOMAIN</p> <p>Length (ft) 1</p> <p>Width (ft) 250</p> </div> </div>													
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.000
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 QUICK DOMENICO.XLS
 SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
 P.A. Domenico (1987)
 Modified to Include Retardation

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
SWLOAD.XLS
A METHOD FOR ESTIMATING
CONTAMINANT LOADING TO
SURFACE WATER
based on
P.A. Domenico (1987)
Modified to Include Retardation

Project:

FPLE/Sunoco

Date:

03/14/2000

Contaminant:

Benzene-MW-141

Prepared by:

Neil Laird

SOURCE CONC (MG/L)	Ax (ft)	Ay (ft)	Az (ft)	LAMBDA day-1	SOURCE WIDTH (ft)	SOURCE THICKNESS (ft)	Time (days)
0.006	> .0001	> .0001	>=.0001	0.000959	100	20	10950

Hydraulic Cond (ft/day)	Hydraulic Gradient (ft/ft)	Porosity (dec. frac.)	Soil Bulk Density (g/cm ³)	KOC	Frac. Org. Carb.	Retard- ation (R)	V (=K ² /h ² R) (ft/day)
1.10E-02	0.0218	0.25	1.7	58	5.00E-03	2.972	0.000323626

SURFACE WATER LOADING GRID

Distance to Stream (ft)	0	-125	-100	-75	-50	0
Plume View Width (ft)	30	0.000	0.000	0.000	0.000	0.000
Plume View Depth (ft)	250	0.000	0.000	0.000	0.000	0.000
	20	0.000	0.000	0.000	0.000	0.000
	-8	0.000	0.000	0.000	0.000	0.000
	-10	0.000	0.000	0.000	0.000	0.000
	-12	0.000	0.000	0.000	0.000	0.000
	-14	0.000	0.000	0.000	0.000	0.000
	-16	0.000	0.000	0.000	0.000	0.000
	-18	0.000	0.000	0.000	0.000	0.000
	-20	0.000	0.000	0.000	0.000	0.000

Mass Loading to Stream

0 MG/DAY

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
Project: FPLE/SSUNOCO														
Date: 03/14/2000		Prepared by: Neil Laird												
		Contaminant: Benzene-MW-118												
		X												
SOURCE CONC (MG/L)	0.05	50	5	0.5	0.001	0.000959	100	20						
		50	5	0.5	0.001	0.000959	100	20						
Hydraulic Cond (ft/day)	5.63E-01	0.0225	0.3	1.7	58	5.00E-03	2.64333333	0.0159855						
		0.0225	0.3	1.7	58	5.00E-03	2.64333333	0.0159855						
Hydraulic Gradient (ft/ft)														
Porosity (dec. frac.)														
Soil Bulk Density (g/cm ³)														
KOC														
Frac. Org. Carb. (R)														
Retardation (=K' ² /in ² R) (ft/day)														
Source Width (ft)														
Source Thickness (ft)														
Distance (ft)														
Conc.														
Projected Conc. at 10950 days														
0.004 mg/l														
AREAL CALCULATION														
MODEL DOMAIN														
Length (ft)	60													
Width (ft)	250													
	6	12	18	24	30	36	42	48	54	60				
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
0	0.037	0.028	0.021	0.016	0.012	0.009	0.007	0.005	0.004	0.003				
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				

PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 QUICK DOMENICO.XLS
 SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
 P.A. Domenico (1987)
 Modified to Include Retardation

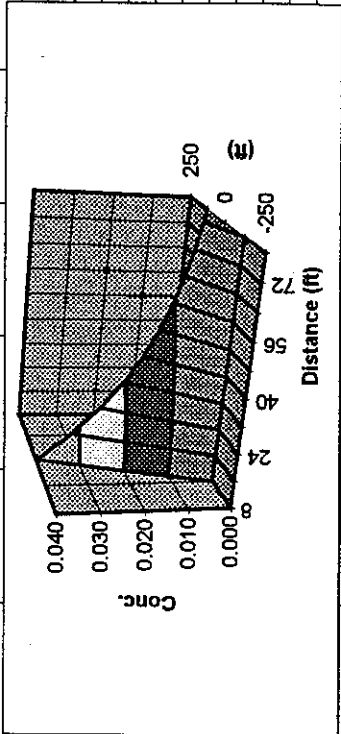
ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION																			
Project:		[FPLE/SSunoco]																	
Date:		05/18/2000																	
Prepared by:		Jeffrey K. Wade																	
Contaminant:		Trichloroethylene-MW145																	
X																			
SOURCE CONC (MG/L)	0.048	DISTANCE T Ax (ft)	15	Az (ft)	1.5	LAMBDA day-1	0.00054795	SOURCE WIDTH (ft)	100	SOURCE THICKNESS (ft)	20								
Hydraulic Cond (ft/day)	5.63E-01	Hydraulic Gradient (ft/ft)	0.0048	Porosity (dec. frac.)	0.3	Soil Bulk Density (g/cm ³)	1.7	KOC		Frac. Org. Carb. (R)	3.635	Retardation (=K*/n*R) (ft/day)	0.00247989	V					
y(ft)		z(ft)		Time (days)															
150		0		0		10950													
Projected Conc. at 10950 days		0																	
at 0.000 mg/l																			
AREAL MODEL		CALCULATION DOMAIN																	
Length (ft)		150																	
Width (ft)		250																	
15		30		45		60		75		90		105		120		135		150	
250	0.000	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
125	0.000	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
0	0.030	0.019		0.010		0.004		0.002		0.000		0.000		0.000		0.000		0.000	
-125	0.000	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
-250	0.000	0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000		0.000	

PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 QUICK_DOMENICO.XLS
 SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
 P.A. Domenico (1987)
 Modified to Include Retardation

ADVECTIVE TRANSPORT WITH THREE-DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION															
Project:		FPLE/SSUNOCO													
Date:		05/18/2000													
Prepared by:		Jeffrey K. Wade													
Contaminant:		Bis(2-ethylhexyl) phthalate-MW145													
X															
SOURCE CONC (MG/L)	0.04	DISTANCE T Ax (ft)	150	Ay (ft)	15	Az (ft)	1.5	LAMBDA day-1	0.00178082	SOURCE WIDTH (ft)	100	SOURCE THICKNESS (ft)	20		
Hydraulic Cond (ft/day)	5.63E-01	Hydraulic Gradient (ft/ft)	0.0048	Porosity (dec. frac.)	0.3	Soil Bulk Density (g/cm ³)	1.7	Frac. Org. Carb.	5.00E-03	Retardation (=K'/ln*R)	2466				
y(ft)		z(ft)		Time (days)											
150		0		0		10950									
Projected Conc. at 10950 days		0													
at 0.000 mg/l															
AREAL CALCULATION															
MODEL DOMAIN															
Length (ft)		250													
Width (ft)		0.1													
250		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
125		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
0		0.023		0.013		0.007		0.004		0.002		0.001		0.000	
-125		0.000		0.000		0.000		0.000		0.000		0.000		0.000	
-250		0.000		0.000		0.000		0.000		0.000		0.000		0.000	

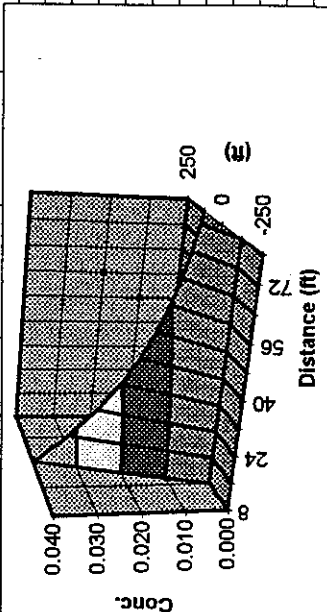
PA DEPARTMENT OF ENVIRONMENTAL PROTECTION
 QUICK_DOMENICO.XLS
 SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"
 P.A. Domenico (1987)
 Modified to Include Retardation

Appendix E
Fate & Transport Model Results Second Run

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION																			
Project:	PPLE/SSUNOCO																		
Date:	06/16/2000																		
Prepared by:	Neil Laird																		
Contaminant:	Benzene-MW-118																		
	X																		
SOURCE	DISTANCE T	Ax	Az	LAMBDA	SOURCE	SOURCE													
CONC	LOCATION	(ft)	(ft)		WIDTH	THICKNESS													
(MG/L)	CONCERN	(ft)	>=.001	day-1	(ft)	(ft)													
0.05	80	8	0.3	0.001	0.000959	100	20												
Hydraulic	Hydraulic			Soil Bulk				Frac.	Retard-										
Cond	Gradient			Density				Org. Carb.	ation										
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)	KOC				(R)	(ft/day)										
5.63E-01	0.0225	0.2	1.3	58	2.50E-03	2.305	0.027497831												
	y(ft)	z(ft)	Time																
	80	0	0	10950															
Projected Conc. at	10950 days																		
at	0.005 mg/l																		
	AREAL CALCULATION																		
	MODEL DOMAIN																		
	Length (ft)	80																	
	Width (ft)	250																	
	8	16	24	32	40	48	56	64	72						80				
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
0	0.040	0.032	0.025	0.020	0.016	0.013	0.010	0.008	0.006	0.005	0.000	0.000	0.000	0.000					
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
QUICK_DOMENICO.XLS
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"

P.A. Domenico (1987)
Modified to Include Retardation



QUICK DOMENICO.XLS

ADVECTIVE TRANSPORT WITH THREE-DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
Project:		FPLE/Sutoco												
Date:		06/15/2000 Prepared by: Neil Laird												
		Contaminant: Dichloromethane-MW:137												
		X												
SOURCE	DISTANCE T	AX	AY	AZ	LAMBDA	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE	SOURCE
CONC	LOCATION	(ft)	(ft)	(ft)	(ft)	WIDTH	THICKNESS	THICKNESS	THICKNESS	THICKNESS	THICKNESS	THICKNESS	THICKNESS	THICKNESS
(MGL)	CONCERN	(ft)	>=0.001	day-1	0.0123	100	20							
0.02	19	1.9	0.19	0.001	0.0123	100	20							
Hydraulic	Hydraulic	Porosity	Soil Bulk	Frac.	Retard-									
Cond	Gradient	(dec. frac.)	Density	Org. Carb.	ation									
(ft/day)	(ft/ft)		(g/cm ³)	(R)	(ft/day)									
2.61E+00	0.0225	0.3	1.7	16	6.00E-03	1.453333333	0.134741972							
	y(ft)	z(ft)	Time											
	19	0	0	10950										
Projected Conc. at	10950 days	19	0	0										
at	0.004 mg/l													
AREAL CALCULATION														
MODEL DOMAIN														
	Length (ft)	30												
	Width (ft)	250												
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.016	0.012	0.010	0.008	0.006	0.005	0.004	0.003	0.002	0.002	0.002	0.002	0.002	0.002
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

PA DEPARTMENT
OF ENVIRONMENTAL PROTECTION
QUICK DOMENICO.XLS
SPREADSHEET APPLICATION OF
"AN ANALYTICAL MODEL FOR
MULTIDIMENSIONAL TRANSPORT OF A
DECAYING CONTAMINANT SPECIES"

P.A. Domenico (1987)
Modified to Include Retardation

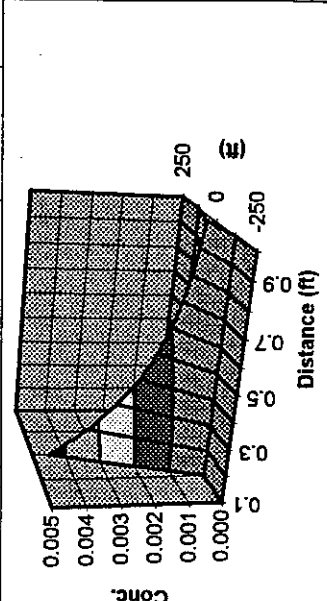
[illegible]

[illegible]

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
Project:		FPLE/SUNOCO												
Date:		03/28/2000 Prepared by: Neil Laird												
		Contaminant: 4-Methylphenol (Cresol)-MW-143												
X														
SOURCE	DISTANCE T	Ax	Ay	Az	LAMBDA	SOURCE	SOURCE	THICKNESS						
CONC	LOCATION	(ft)	(ft)	(ft)	day-1	WIDTH	WIDTH	(ft)						
(MGL)	CONCERN	(ft)	>=0.001											
0.22	2	0.2	0.02	0.001	0.041	100	42							
Hydraulic	Hydraulic		Soil Bulk		Frac.	Retard-	V							
Cond	Gradient	Porosity	Density	KOC	Org. Carb.	ation	(=K ² /in ² R)							
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)		(R)	(ft/day)								
2.28E-02	0.41	0.2	1.8	26	2.60E-03	1.626	0.03006792							
	y(ft)	z(ft)	Time											
			(days)											
	2	0	0	10960										
Projected Conc. at	10960 days	2	0											
at	0.093 mg/l													
AREAL CALCULATION														
MODEL DOMAIN														
Length (ft)	200													
Width (ft)	10													
1	2	3	4	5	6	7	8	9	10					
200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000					
0	0.143	0.093	0.060	0.039	0.025	0.016	0.011	0.007	0.005	0.003				
-100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				
-200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000				

PA DEPARTMENT
 OF ENVIRONMENTAL PROTECTION
 QUICK_DOMENICO.XLS
 SPREADSHEET APPLICATION OF
 "AN ANALYTICAL MODEL FOR
 MULTIDIMENSIONAL TRANSPORT OF A
 DECAYING CONTAMINANT SPECIES"
 P.A. Domenico (1987)
 Modified to Include Retardation

ADVECTIVE TRANSPORT WITH THREE DIMENSIONAL DISPERSION AND 1ST ORDER DECAY AND RETARDATION														
<div> <div>PA DEPARTMENT OF ENVIRONMENTAL PROTECTION QUICK_DOMENICO.XLS SPREADSHEET APPLICATION OF "AN ANALYTICAL MODEL FOR MULTIDIMENSIONAL TRANSPORT OF A DECAYING CONTAMINANT SPECIES"</div> <div>P.A. Domenico (1987) Modified to Include Retardation</div> </div>														
Project:		FPLE/Ssunoco												
Date:		03/14/2000												
Prepared by:		Neil Laird												
Contaminant:		Benzene-MW 141												
X														
SOURCE	DISTANCE T	Ax	Az	LAMBDA	SOURCE	SOURCE	THICKNESS							
CONC	LOCATION	(ft)	(ft)				(ft)							
(MGL)	CONCERN	(ft)	>=.001	day-1										
0.006	0.1	0.01	0.001	0.000959	100	20								
Hydraulic	Hydraulic	Soil Bulk	Frac.	Retard-										
Cond	Gradient	Porosity	Density	ation										
(ft/day)	(ft/ft)	(dec. frac.)	(g/cm ³)	(=K'/in*R)										
1.10E-02	0.013	0.2	1.8	58	2.50E-03	2.30E-03	0.000311041							
	y(ft)	z(ft)	Time											
	0.1	0	0	10950										
Projected Conc. at	10950 days													
at	0.004 mg/l													
AREAL CALCULATION														
MODEL DOMAIN														
Length (ft)		250												
Width (ft)		1												
250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
0	0.004	0.003	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
-125	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
-250	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000



Appendix F
Construction Worker Exposure Calculation

CONSTRUCTION WORKER EXPOSURE SCENARIO SUNOCO MARCUS HOOK, PHILLIPS ISLAND

Risk-based reference concentrations were needed to evaluate exposure potential to a hypothetical construction worker assumed to be engaged in intrusive activities that would bring the worker in contact with residual constituents in soil. To evaluate this exposure scenario, the worker was assumed to be exposed by way of inhalation of volatile constituents emanating from the soil, by way of incidental ingestion of soil during the work day, and by way of dermal contact with soil.

The general algorithm for exposure of a construction worker was taken from the Texas Natural Resource Conservation Commission's (TNRCC's) petroleum storage tank program (TNRCC, 1997). It was assumed that a construction worker would be engaged in construction activities involving excavation for 5 days/week over a period of 12 weeks during a single year. For exposure to carcinogenic constituents, exposure dose received over the 12-week exposure period was apportioned over a 70-year lifetime. For noncarcinogenic constituents, exposure dose received over the 1-year exposure duration was used as the basis for the calculation of risk-based target concentrations. The worker was assumed to have 3,300 cm² of exposed skin, which amounts of the head, forearms, and arms (TNRCC, 1997). The amount of soil adherence to exposed skin was assumed to be 0.12 mg/cm² (TNRCC, 1997). There are no existing dermal absorption values for constituents in the soil medium; as an alternative, default values were obtained from the TNRCC's Texas Risk Reduction Program (TRRP; TNRCC, 1999). The amount of soil incidentally ingested by way of hand-to-mouth contact during a workday was assumed to be 480 mg/day (TNRCC, 1997; EPA, 1991a). For inhalation exposure, it was assumed that a 0.5 acre source area existed and that the construction worker would be exposed by inhalation of respirable-fraction dust and vapors of volatile constituents having a Henry's Law constant of at least 1E-05 atm-m³/mol or greater and a molecular weight of 200 g/mol or less (EPA, 1991b). Volatilization factors for individual volatile constituents and the particulate emission factor for a 0.5 acre source area (i.e., an area that is assumed to contain constituents in the soil) were calculated using the algorithms and default input parameters contained in EPA's Soil Screening Guidance (1996a, b). Chemical properties data were obtained from the Soil Screening Guidance (EPA, 1996a, b); missing values were taken from chemical properties tables included in the TNRCC's TRRP (TNRCC, 1999).

Toxicity data needed for calculation of risk-based target concentrations were obtained from EPA's Integrated Risk Information System (IRIS; EPA, 2000). Missing toxicity data were supplemented with data obtained from EPA's Health Effects Assessment Summary Tables (HEAST; EPA, 1995) and TNRCC's TRRP (TNRCC, 1999). Gastrointestinal absorption values needed for conversion of oral toxicity data to dermal toxicity data were obtained from the TNRCC's TRRP (TNRCC, 1999).

Risk-based target concentrations for constituents in soil are contained in accompanying spreadsheets. Note that for carcinogenic constituents, the reference concentrations correspond to the lower of a one-in-one million cancer risk (i.e., 1E-06 cancer risk) or a hazard index of one. For noncarcinogenic constituents, the reference concentrations correspond to a hazard index of one.

References Cited:

EPA, 2000. Integrated Risk information System. <http://www.epa.gov/iris>

EPA, 1996a. Soil Screening Guidance: User's Guide. U.S. Environmental Protection Agency. Publication 9355.4-23. EPA/540/R-96/018. PB96-963505.

EPA, 1996b. Soil Screening Guidance: Technical Background Document. U.S. Environmental Protection Agency. Publication 9355.4-17A. EPA/540/R-95/128. PB96-963502.

EPA, 1995. Health Effects Assessment Summary Tables. FY-1995 Annual. U.S. Environmental Protection Agency. Publication 9200.6-303 (95-1). EPA/540/R-95/036. PB95-921199.

EPA, 1991a. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". U.S. Environmental Protection Agency. OSWER Directive 9285.6-03. March 25, 1991.

EPA, 1991b. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals. Interim. U.S. Environmental Protection Agency. Publication 9285.7-01B. PB96-963333.

TNRCC, 1999. Texas Risk Reduction Program. Texas Natural Resource Conservation Commission. <http://www.tnrcc.state.tx.us>.

TNRCC, 1997. Clarifications and Amendments for Implementation of RG-36. Texas Natural Resource Conservation Commission. Memorandum from Chet Clarke, Director of Programs, Petroleum Storage Tank Division, to PST Corrective Action Coordinators. March 6, 1997.

Appendix G
Industrial Worker Exposure Calculation

EVALUATION OF CUMULATIVE RISK FOR THE SOIL MEDIUM ASSUMING AN INDUSTRIAL WORKER EXPOSURE SCENARIO

Objective

An evaluation of cumulative cancer and noncancer risk resulting from assumed exposure to multiple constituents in soil by way of direct contact during daily industrial activities (pre or post-construction) was desired on a parcel of property at the Sunoco, Inc. (R&M) Marcus Hook facility, Phillips Island site. (Daily industrial activities do not include intrusive construction activities that were addressed in Appendix N.) Soil is the sole environmental medium in this evaluation. Assumed exposure of an industrial worker due to direct contact with soil in an outdoor setting is the exposure scenario evaluated in the text to follow.

Approach Used for the Analysis

The general algorithms and exposure assumptions for calculation of risk-based reference concentrations assuming nonresidential exposure (i.e., continued industrial use of the parcel) were obtained from the Pennsylvania Land Recycling Program, which is known as Act 2 (PADEP, 1997). Additional algorithm components, such as a dermal component, were obtained from other sources (TNRCC, 1999; 1997). To perform the cumulative risk analysis, risk-based reference concentrations were calculated for simultaneous exposure via inhalation of vapors and dust from the area, dermal contact with the surface soil, and incidental ingestion of surface soil. Consistent with the method used to establish statewide health standards in Section 250.305 of Act 2, nonresidential soils are defined as 0-2 feet in depth for purposes of evaluation of the ingestion exposure route (although not required under Act 2, the risk assessor also incorporated the dermal exposure route as well). For evaluation of the vapor and dust exposure pathways under a nonresidential setting, in an approach consistent with the method used to establish statewide health standard in Section 250.305 of Act 2, the top 15 feet of soil was evaluated. This cumulative risk evaluation conservatively included consideration of the top 20 feet of soil as subsurface soil because the proposed future use of the parcel includes leveling operations in some sections of the parcel that could change the topography by a foot or more. The proposed finished grade of the main section of the proposed future use of the parcel is 24.5 feet (refinery datum), which would result in less than five feet of reduction in current elevation. Section 250.1 of Act 2 defines volatile constituents as those constituents having a Henry's Law constant of $1\text{E-}05$ atm-m³/mol or greater and a molecular weight of 200 g/mol or less.

A spreadsheet attached to this evaluation contains risk-based reference values for an industrial worker assumed to be exposed for 180 days/year over a 25-year working lifetime (exposure assumptions per 250.305 of Act 2). For the cumulative risk analysis, both cancer-based and noncancer-based reference concentrations were needed. For carcinogenic constituents, the reference concentrations presented in the spreadsheet correspond to a one-in-one million cancer risk. For noncarcinogenic constituents, the reference concentrations correspond to a hazard index of 1.

Toxicity data needed for calculation of risk-based reference concentrations were obtained from EPA's Integrated Risk Information System (IRIS; EPA, 2000a). Missing toxicity data were supplemented with data obtained from EPA's Health Effects Assessment Summary Tables (HEAST; EPA, 1995). Provisional toxicity data were obtained from Region III EPA's Risk-Based Concentration Table (EPA, 2000b). Additional toxicity data were obtained from the Texas Natural Resource Conservation Commission's (TNRCC's) Texas Risk Reduction Program

(TRRP; TNRCC, 1999). Gastrointestinal absorption values needed for conversion of oral toxicity data to dermal toxicity data were obtained from the TNRCC's TRRP (TNRCC, 1999).

Cumulative cancer and noncancer risks for multiple constituents in soil are contained in an accompanying spreadsheet. Cumulative risk for carcinogenic constituents was calculated by dividing the maximum detected constituent concentration detected in site soil by reference concentrations that correspond to a one-in-one million cancer risk (i.e., $1\text{E-}06$ cancer risk) and multiplying the resulting value by $1\text{E-}06$. The resulting value corresponds to the cancer risk presented by assumed exposure to a single carcinogenic constituent by way of inhalation, dermal contact, and ingestion. As EPA (1991) considers all carcinogenic endpoints to be the same, cancer risk is additive regardless of the site of tumor development. Thus, cancer risk presented by each constituent present in soil was summed to yield a total cancer risk.

To further explain the method used in calculating cumulative risk, the following example calculation is presented:

Alpha-hexachlorocyclohexane (also known as alpha-BHC), a nonvolatile constituent, is present in surface soil at 49 milligrams per kilogram (mg/kg). Benzene, a volatile constituent, is present in surface soil at 0.27 mg/kg and in subsurface soil at 21 mg/kg. The $1\text{E-}06$ cancer risk reference value for inhalation of benzene from surface and subsurface soil is 22.9 mg/kg. A reference concentration was not established for the dermal route because volatile constituents were assumed to volatilize from soil deposited on the skin before dermal penetration could occur (TNRCC, 1999). The surface soil ingestion reference for benzene is 274 mg/kg. The inhalation, dermal, and ingestion reference values for alpha-BHC in surface soil (surface soil only is relevant for alpha-BHC because the constituent does not meet the Act 2 volatility criteria) are 70,400 mg/kg, 1.59 mg/kg, and 1.26 mg/kg, respectively. Total cancer risk for benzene is calculated by dividing the greater of the surface and the subsurface soil concentration (in this case, 21 mg/kg) by the inhalation reference value that corresponds to a $1\text{E-}06$ cancer risk (i.e., 22.9 mg/kg) and multiplying the resulting value by $1\text{E-}06$. The result is $21\text{ mg/kg} / 22.9\text{ mg/kg} \times 1\text{E-}06 = 9.15\text{E-}07$ benzene cancer risk for the inhalation route alone. Adding the cancer risk due to exposure to benzene in soil by way of ingestion, a cancer risk of $9.85\text{E-}10$ is generated ($0.27\text{ mg/kg} / 274\text{ mg/kg} \times 1\text{E-}06 = 9.85\text{E-}10$ cancer risk due to ingestion). Adding the two benzene cancer risk values together, a total cancer risk due to exposure to benzene alone is $9.15\text{E-}07 + 9.85\text{E-}10 = 9.16\text{E-}07$.

Performing the same calculation for alpha-BHC, a total cancer risk due to assumed exposure to alpha-BHC in surface soil by way of inhalation of dust (the constituent is not volatile), dermal contact, and ingestion is $6.96\text{E-}05$ (risks of $6.96\text{E-}10$ for inhalation of dust, $3.08\text{E-}05$ for dermal contact, and $3.88\text{E-}05$ for ingestion = $6.96\text{E-}05$ cancer risk). Adding the total cancer risk calculated for benzene, $9.16\text{E-}07$, to the total cancer risk calculated for alpha-BHC, $6.96\text{E-}05$, a total cumulative cancer risk of $7.05\text{E-}05$ is obtained. This approach is the same used to generate cumulative cancer risk in the attached spreadsheet for approximately 20 carcinogenic constituents detected in soil at the site.

For noncarcinogenic constituents, cumulative noncancer risk was generated by dividing the maximum detected constituent concentration in soil by the risk-based reference concentration that corresponded to a hazard index of one. The resulting value represented the hazard index for an individual constituent assuming exposure by way of inhalation, dermal contact, and ingestion. Because EPA (1991) recognizes that noncarcinogenic constituents may exert toxic action on different target organs, cumulative noncancer risk conventionally is generated by summing hazard indices for individual constituents exerting their toxic effects on the same target organ to

result in a total hazard index. Using mercury and cadmium to illustrate the calculation process, the following example hazard index calculation results: For mercury, which is present in surface soil at 4.3 mg/kg, the noncancer reference values are 12,220,000 mg/kg for inhalation of dust from soil, 753 mg/kg for dermal exposure, and 852 mg/kg for ingestion of soil containing mercury. The noncancer reference values for cadmium, present in surface soil at 5.0 mg/kg, are 8,090,000 mg/kg for the inhalation route, 896 mg/kg for the dermal route, and 2,840 mg/kg for the ingestion route. Dividing the surface soil concentration by the mercury inhalation reference value that corresponds to a hazard index of 1 (more correctly, a hazard quotient, because a single constituent and a single route of exposure are involved), a hazard quotient of $3.52\text{E-}07$ results (i.e., $4.3 \text{ mg/kg} / 12,220,000 \text{ mg/kg} = 3.52\text{E-}07$). Adding the hazard quotients due to dermal contact and ingestion of surface soil containing mercury, which are $5.71\text{E-}03$ and $5.05\text{E-}03$, respectively, to the hazard quotient for inhalation of mercury, a hazard index for exposure to mercury alone is $1.08\text{E-}02$ ($3.52\text{E-}07 + 5.71\text{E-}03 + 5.05\text{E-}03 = 1.08\text{E-}02$). Performing the same calculations for cadmium, a hazard index of $7.34\text{E-}03$ results for that constituent. Assuming that both mercury and cadmium act on the same target organ, a cumulative hazard index of $1.81\text{E-}02$ results for assumed concurrent exposure to the two constituents in soil ($1.08\text{E-}02 + 7.34\text{E-}03 = 1.81\text{E-}02$). This approach is the same used to generate cumulative noncancer risk in the attached spreadsheet for 35 constituents detected in soil at the Facility.

Human Health Protection Goals

Section 250.402 of Act 2 (PADEP, 1997) specifies that the human health protection goals required in the State of Pennsylvania consist of a cumulative excess cancer risk between $1\text{E-}06$ and $1\text{E-}04$ (i.e., one excess cancer per 10,000) and a cumulative hazard index of 1. These health protection goals are used as the basis for comparison with the cumulative risk analysis in the attached spreadsheet. From the example calculations above with carcinogenic constituents, the cumulative risk of benzene and alpha-BHC are within the cumulative excess cancer risk range. For noncarcinogenic constituents, assuming that only cadmium and mercury were present in the soil, there would be no need for evaluation of remedial options because the cumulative hazard index was less than 1.

Result of the Cumulative Risk Analysis

The results of the cumulative risk analysis are presented in Table 1. The spreadsheet containing the details of the cumulative risk analysis is attached. From Table 1, the upper bound health protection goal for carcinogenic constituents (i.e., $1\text{E-}04$) and the health protection goal for noncarcinogenic constituents (i.e., 1) were not exceeded. The primary contributor to cumulative cancer risk above the lower end of the health protection goal (i.e., $1\text{E-}06$ cancer risk) was alpha-BHC, which contributed 84 percent of the total cumulative cancer risk.

Table 1
Result of the Cumulative Risk Analysis
Phillips Island, Marcus Hook

Target Cumulative Cancer Risk	Total Cumulative Cancer Risk	Primary Contributor to Cancer Risk
1E-04	8.31E-05	alpha-BHC
Target Cumulative Noncancer Risk	Total Cumulative Noncancer Risk	Primary Contributor to Noncancer Risk
1	0.175	Not applicable

Uncertainty Statement

The cumulative risk evaluation for the soil medium did not include data collected from saturated soil. Saturated soil typically is addressed as a groundwater issue; thus, no consideration was given to constituent presence in saturated soil. This analysis did include data for unsaturated soil collected from the 0 to 20-foot depth. While applying an approach consistent to the Act 2 statewide health standards requires evaluation of only the top 15 feet of soil for potential direct contact (by way of inhalation of vapors) anticipated minor land leveling activities on a portion of the parcel caused extension of the Act 2 depth to a more conservative depth of 20 feet. [For all parameters except for benzene and dichloromethane detected in one sample (1,700 mg/kg and 67 JB mg/kg, respectively, in B-PH8, 24-26 feet bgs), there were no concentrations below 20 feet bgs greater than concentrations above 20 feet bgs.]

Although Act 2 does not require evaluation of the dermal route of exposure for constituents in soil, the risk assessor included the dermal route of exposure because of the presence of semivolatile constituents detected in surface soil. Semivolatile constituents are the most likely constituents to penetrate intact skin when the soil medium is considered. However, including the dermal pathway roughly doubled the risk over the soil ingestion route alone. Hence, the total cancer risk calculated for alpha-BHC, a pesticide that has the properties of a semivolatile constituent, is increased by approximately 2-fold. In addition, use of an assumed completely exposed head, arms, and hands likely is conservative in a typical plant setting, where workers are required to wear protective clothing such as hard hats and fire-resistant long-sleeve coveralls.

Yet another source of uncertainty introduced into the cumulative risk analysis is the use of maximum detected concentrations in surface or subsurface soils rather than the use of statistically-based upper bound constituent concentrations. Assuming that the data were suitable for statistical representation, it is probable that use of maximum detected concentrations overstates the true risk potential.

Summary

The result of a conservative cumulative risk analysis performed for the land parcel of interest on the Sunoco, Inc. Marcus Hook, Phillips Island site was that cumulative cancer risk was within the range of risks constituting the health protection goal for lands in Pennsylvania. Alpha-BHC in surface soil was the primary contributor to cancer risk. Cumulative noncancer risk was less than the target health protection goal of a hazard index of 1.

References Cited:

EPA, 2000a. Integrated Risk information System. U.S. Environmental Protection Agency. <http://www.epa.gov/iris>

EPA, 2000b. Risk-Based Concentration Table. U.S. Environmental Protection Agency. EPA Region III. Philadelphia, PA. <http://www.epa.gov/reg3hwmd/risk/riskmenu.htm>. April 13, 2000.

EPA, 1995. Health Effects Assessment Summary Tables. FY-1995 Annual. U.S. Environmental Protection Agency. Publication 9200.6-303 (95-1). EPA/540/R-95/036. PB95-921199.

EPA, 1991. Risk Assessment Guidance for Superfund: Volume I - Human Health Evaluation Manual (Part B, Development of Risk-Based Preliminary Remediation Goals. Interim. U.S. Environmental Protection Agency. Publication 9285.7-01B. PB96-963333.

PADEP, 1997. Land Recycling Program. 25 Pennsylvania Code. Chapter 250. Pennsylvania Department of Environmental Protection.

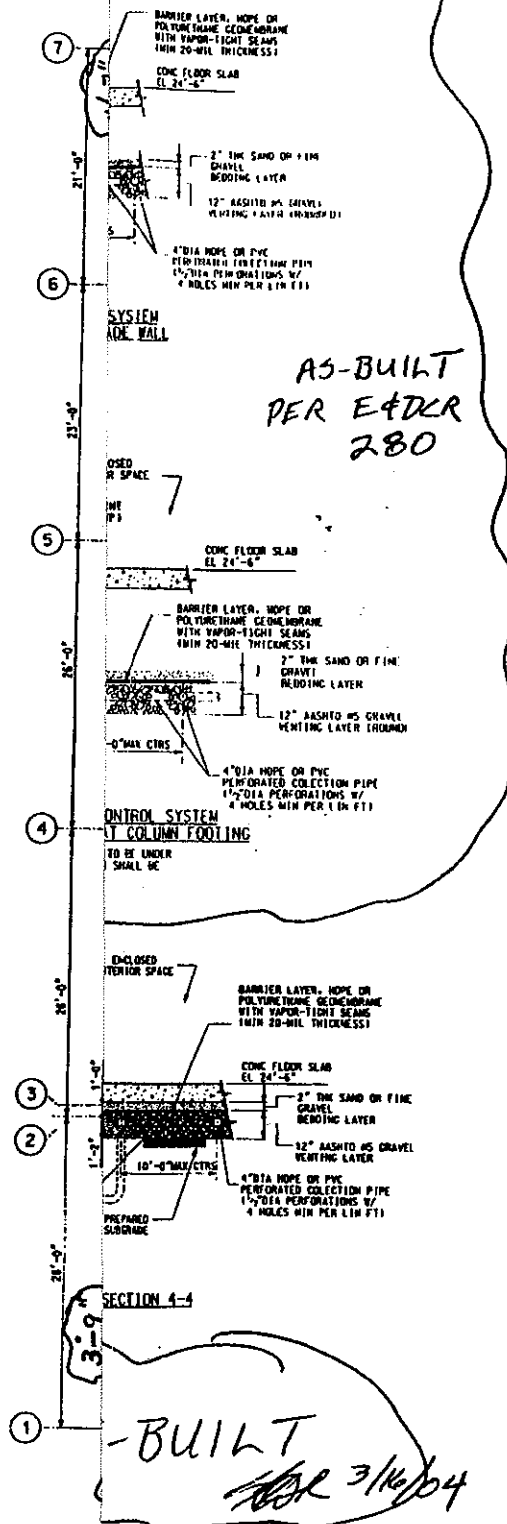
TNRCC, 1999. Texas Risk Reduction Program. Texas Natural Resource Conservation Commission. <http://www.tnrcc.state.tx.us>.

TNRCC, 1997. Clarifications and Amendments for Implementation of RG-36. Texas Natural Resource Conservation Commission. Memorandum from Chet Clarke, Director of Programs, Petroleum Storage Tank Division, to PST Corrective Action Coordinators. March 6, 1997.

Appendix H
Passive Vapor Control System

13260-EC-25B-0

NORTH
↑



ADMIN. / CONTROL / MAINT.
PASSIVE GAS
CONTROL SYSTEM

FPL ENERGY MARCUS HOOK, L.P.
MARCUS HOOK, PENNSYLVANIA

STONE & WEBSTER, INC.
CHERRY HILL, NJ

DESIGNED BY: P&T
CHECKED BY: P&T
DATE: 3/16/04

DESIGN CHECKED BY: P&T
CHECKED BY: P&T

AS-BUILT

Appendix I
Sheet Pile Barrier Wall

Date: June 25, 2002

To: Jim Oppenheim (Sunoco), Steve Gucciardi (Sunoco)

cc: James Amorebella (Stone & Webster), Sharon Roberts (URS)

From: Chul Woo Kim, Jamie Coffman

Subject: **Summary of Cut-off Wall Installation**

PROJECT DESCRIPTION

The sheetpile cut-off wall planned along the south-west edge of Philips Island in Sunoco Marcus Hook was installed from May 31 to June 17, 2002 by Commerce Construction Corporation. A total of 55 sheetpile 'double-piles' (each 4.13 feet long) were installed. Installed cut-off wall length is therefore approximately 227 ft.

A URS field representative, Chul Woo Kim, observed the installation of sheetpiles on a full-time basis and performed the following general tasks:

- Inspected delivered sheetpiles for damage and distortion, including surface coating, interlock joints, continuous seal welds and Roxan joint sealant coverage/uniformity.
- Confirmed Roxan was installed in the 'following' interlock of each double-pile section.
- Inspected stored sheetpiles to confirm interlock joints containing Roxan were facing downward.
- Checked application of soap solution to pre-installed Roxan sealant (for lubrication).
- Confirmed that Roxan cleaning tool was installed in the 'lead' interlock of preceding installed sheetpile.
- Observed driving of sheetpiles.
- Observed that all sheetpiles were driven within 2 hours following start of driving.
- Checked vertical plumbness of sheetpiles to maintain overall wall alignment and stability and to allow for setting and driving adjoining pile sections.
- Recorded driving information for each sheetpile including type of hammer, estimated ground surface elevation, pile advance rate (for vibratory hammer), blow counts (for impact hammer), total driving time, depths of difficult driving, pile tip and cut-off elevations, and pile length (cut-off to tip).

MATERIALS

AZ-18 continuously-welded 'double-piles' with interlock sealant ('Roxan' system) from Skyline Steel were used to construct the cut-off wall. Sheetpiles were factory-coated with coal tar epoxy and supplied with a delivered length of 65 ft.

WORK SUMMARY

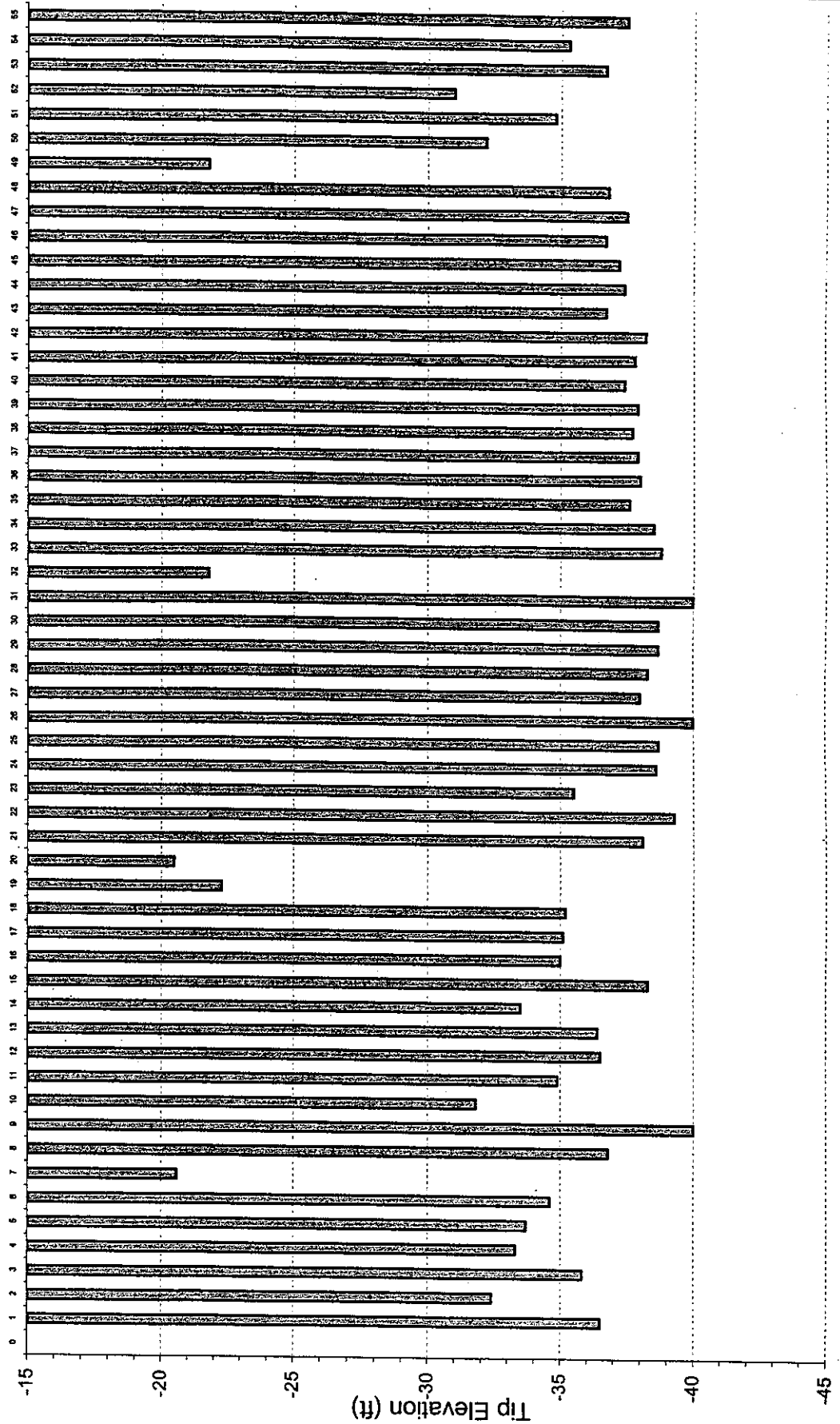
At the start of pile driving, the ground surface elevation ranged from El.15 ft to El.20 ft along the wall alignment. All 55 piles were partially or fully driven using a vibratory hammer (ICE 44-65). If a pile driven by vibratory hammer achieved 'refusal' prior to the desired termination depth, it was considered as 'obstructed' and further driven to depth by using an impact hammer (Dawson HPH-2400). Of the 55 sheetpiles driven, 7 piles were considered as 'obstructed' and further driven by using an impact hammer. As shown in the attached PROFILE, of the 7 obstructed piles, 5 piles (Pile # 7, 19, 20, 32, and 49) met refusal using the impact hammer at relatively greater depth, corresponding to tip elevations ranging from El. -20.5 to El. -22.3 ft. 10 blows per inch for three continuous inches was used as refusal criterion when using an impact hammer. The range and average values of pile driving parameters are summarized below:

	Range (min. to max.)	Average
Ground Surface Elev.(ft)	Approx. 15 to 20	-
Driven Depth (ft, bgs)	38.9 to 58.5	53.9
Driving Time (min)	8 to 33	15.7
Cut-off to Tip Length (ft)	45.5 to 65.0	60.3
Tip Elevation (ft)	El. -20.5 to -40.0	El. -35.3

For detailed driving records of each sheetpile, refer to the attached SHEETPILE DRIVING SUMMARY.

PROFILE FOR SUNOCO MARCUS HOOK PHILIPS ISLAND CUT-OFF WALL

Sheetpile No.





SHEETPILE DRIVING SUMMARY

Job Number: 24-25995049.00

Job Name: Sunono Marcus Hook Philips Island Cut-off Wall

Pile Type: AZ-18 double sheetpile with interlock sealing

Hammer: A = Vibratory Hammer (ICE 44-65)

B = Impact Hammer (Dawson HPH-2400)

Contractor: Commerce Construction Corporation

Pile Mark Numbers	Sealant Pile Sequence	Driving Date	Delivered Pile Length (ft)	Driven Length (ft.bgs)	Cut-off Elevation (ft)	Cut-off to Tip Length (ft)	Tip Elevation (ft)	Hammer Used	Driving Time (min)	Terminal Resist. ³ (blows/inch)
K101 ¹	-	NA	NA	NA	25.0	NA	NA	NA	NA	NA
K102	1	05/31/02	65.0	58.0	25.0	61.5	-36.5	A	NA	
K103	2	05/31/02	65.0	54.0	25.0	57.4	-32.4	A	NA	
K104	3	06/03/02	65.0	57.0	25.0	60.8	-35.8	A	12	
K105	4	06/03/02	65.0	55.0	25.0	58.3	-33.3	A	17	
K106	5	06/03/02	65.0	55.0	25.0	58.7	-33.7	A	10	
K107	6	06/03/02	65.0	53.0	25.0	59.6	-34.6	A	11	
K108	7	06/03/02	65.0	38.9	25.0	45.6	-20.6	A & B	21	60/5"
K109	8	06/03/02	65.0	55.0	25.0	61.8	-36.8	A	12	
K110	9	06/04/02	65.0	58.0	25.0	65.0	-40.0	A	28	
K111	10	06/04/02	65.0	49.8	25.0	56.8	-31.8	A & B	30	60/4"
K112	11	06/04/02	65.0	53.0	25.0	59.9	-34.9	A	15	
K113	12	06/04/02	65.0	54.0	25.0	61.5	-36.5	A	12	
K114	13	06/04/02	65.0	54.0	25.0	61.4	-36.4	A	14	
K115	14	06/04/02	65.0	51.0	25.0	58.5	-33.5	A	26	
K116	15	06/04/02	65.0	56.0	25.0	63.3	-38.3	A	21	
K117	16	06/04/02	65.0	52.5	25.0	60.0	-35.0	A	13	
K118	17	06/05/02	65.0	52.5	25.0	60.1	-35.1	A	16	
K119	18	06/05/02	65.0	52.0	25.0	60.2	-35.2	A	13	
K120	19	06/05/02	65.0	39.0	25.0	47.3	-22.3	A & B	33	15/1"
L101	20	06/06/02	65.0	41.0	25.0	45.5 ²	-20.5	A & B	18	50/3"
L102	21	06/06/02	65.0	55.0	25.0	63.1	-38.1	A	12	
L103	22	06/06/02	65.0	56.0	25.0	64.3	-39.3	A	16	
L104	23	06/06/02	65.0	53.0	25.0	60.5	-35.5	A & B	22	70/6"
L105	24	06/06/02	65.0	55.5	25.0	63.6	-38.6	A	13	
L106	25	06/06/02	65.0	56.0	25.0	63.7	-38.7	A	13	
L107	26	06/07/02	65.0	57.0	25.0	65.0	-40.0	A	11	
L108	27	06/07/02	65.0	55.0	25.0	63.0	-38.0	A	26	
L109	28	06/07/02	65.0	54.5	25.0	63.3	-38.3	A	NA	
L110	29	06/07/02	65.0	55.0	25.0	63.7	-38.7	A	NA	
L111	30	06/10/02	65.0	56.0	25.0	63.7	-38.7	A	13	
L112	31	06/10/02	65.0	58.0	25.0	65.0	-40.0	A	11	
L113	32	06/10/02	65.0	39.0	25.0	46.8	-21.8	A & B	19	100/6"
L114	33	06/10/02	65.0	56.0	25.0	63.8	-38.8	A	16	
L115	34	06/10/02	65.0	56.0	25.0	63.5	-38.5	A	10	
L116	35	06/10/02	65.0	55.0	25.0	62.6	-37.6	A	11	
L117	36	06/10/02	65.0	55.5	25.0	63.0	-38.0	A	11	
L118	37	06/10/02	65.0	55.5	25.0	62.9	-37.9	A	19	
L119	38	06/10/02	65.0	55.0	25.0	62.7	-37.7	A	9	
L120	39	06/10/02	65.0	55.5	25.0	62.9	-37.9	A	8	



SHEETPILE DRIVING SUMMARY

Job Number: 24-25995049.00

Job Name: Sunono Marcus Hook Philips Island Cut-off Wall

Pile Type: AZ-18 double sheetpile with interlock sealing

Hammer: A = Vibratory Hammer (ICE 44-65)

B = Impact Hammer (Dawson HPH-2400)

Contractor: Commerce Construction Corporation

Pile Mark Numbers	Sealant Pile Sequence	Driving Date	Delivered Pile Length (ft)	Driven Length (ft.bgs)	Cut-off Elevation (ft)	Cut-off to Tip Length (ft)	Tip Elevation (ft)	Hammer Used	Driving Time (min)	Terminal Resist. ^{*3} (blows/inch)
L121	40	06/11/02	65.0	55.0	25.0	62.4	-37.4	A	11	
L122	41	06/11/02	65.0	55.5	25.0	62.8	-37.8	A	9	
L123	42	06/11/02	65.0	56.5	25.0	63.2	-38.2	A	9	
L124	43	06/11/02	65.0	56.0	25.0	61.7	-36.7	A	20	
L125	44	06/11/02	65.0	57.0	25.0	62.4	-37.4	A	8	
L126	45	06/11/02	65.0	57.0	25.0	62.2	-37.2	A	11	
L127	46	06/12/02	65.0	55.5	25.0	61.7	-36.7	A	12	
L128	47	06/12/02	65.0	56.5	25.0	62.5	-37.5	A	12	
L129	48	06/12/02	65.0	56.5	25.0	61.8	-36.8	A	20	
L130	49	06/12/02	65.0	43.0	25.0	46.8	-21.8	A & B	33	75/6"
L131	50	06/13/02	65.0	53.0	25.0	57.2	-32.2	A	12	
M101	51	06/13/02	65.0	57.0	25.0	59.8	-34.8	A	16	
M102	52	06/13/02	65.0	54.5	25.0	56.0	-31.0	A	18	
M103	53	06/13/02	65.0	58.0	25.0	61.7	-36.7	A	12	
M104	54	06/13/02	65.0	56.5	25.0	60.3	-35.3	A	19	
M105	55	06/13/02	65.0	58.5	25.0	62.5	-37.5	A	15	

Notes:

*1: Non-sealant pile driven by contractor

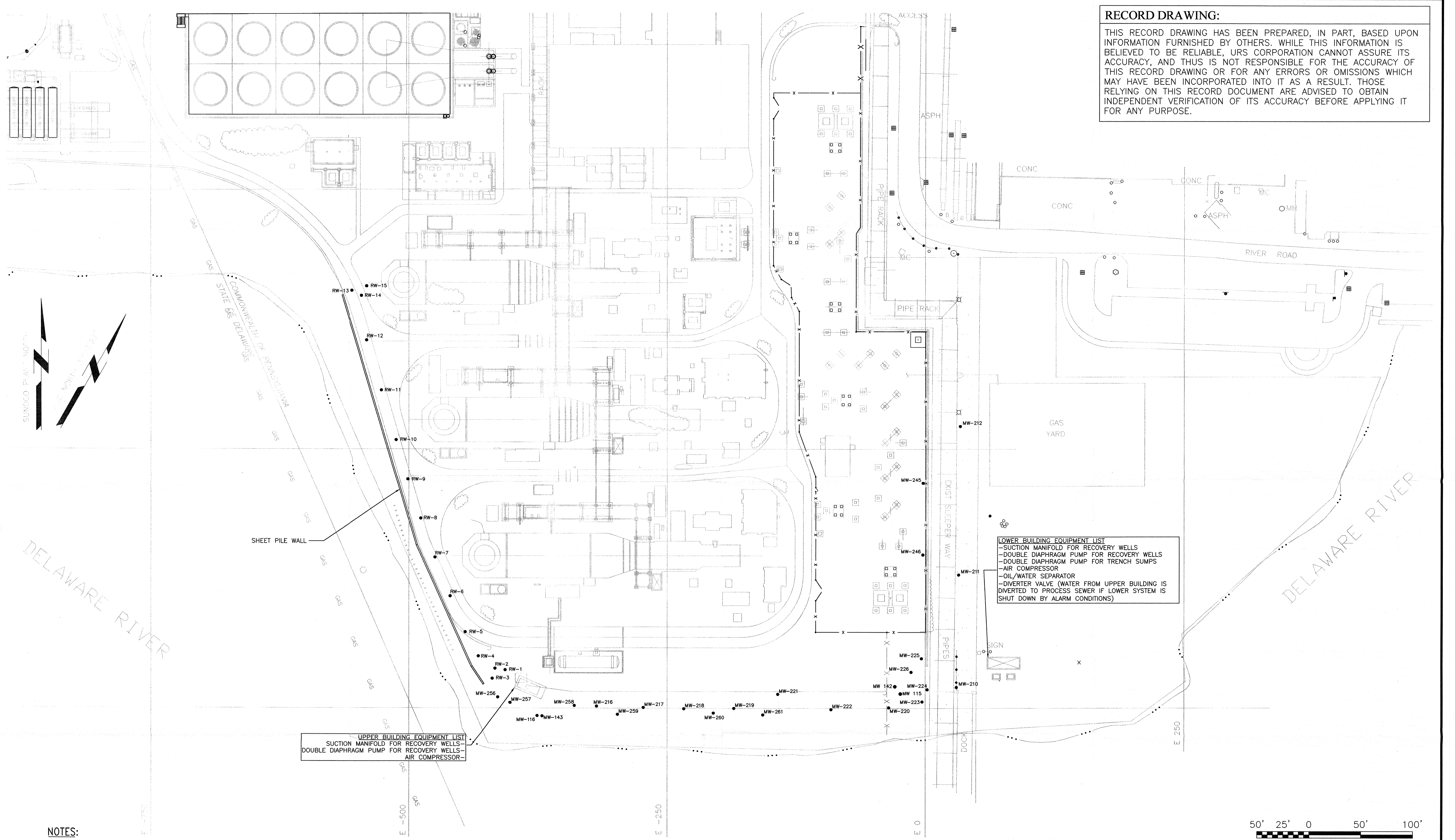
*2: 48.5' (mark at cut-off) - 3' (cut due to deformation at tip) = 45.5'

*3: Impact hammer only

Appendix J
LNAPL Control And Recovery System

RECORD DRAWING:

THIS RECORD DRAWING HAS BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, URS CORPORATION CANNOT ASSURE ITS ACCURACY, AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THIS RECORD DRAWING OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO IT AS A RESULT. THOSE RELYING ON THIS RECORD DOCUMENT ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

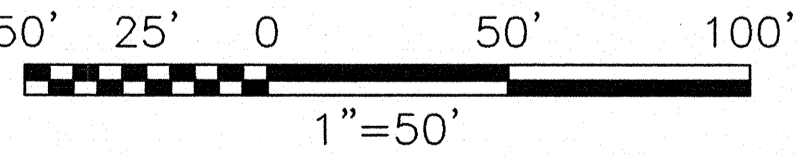


UPPER BUILDING EQUIPMENT LIST
-SUCTION MANIFOLD FOR RECOVERY WELLS
-DOUBLE DIAPHRAGM PUMP FOR RECOVERY WELLS
-AIR COMPRESSOR

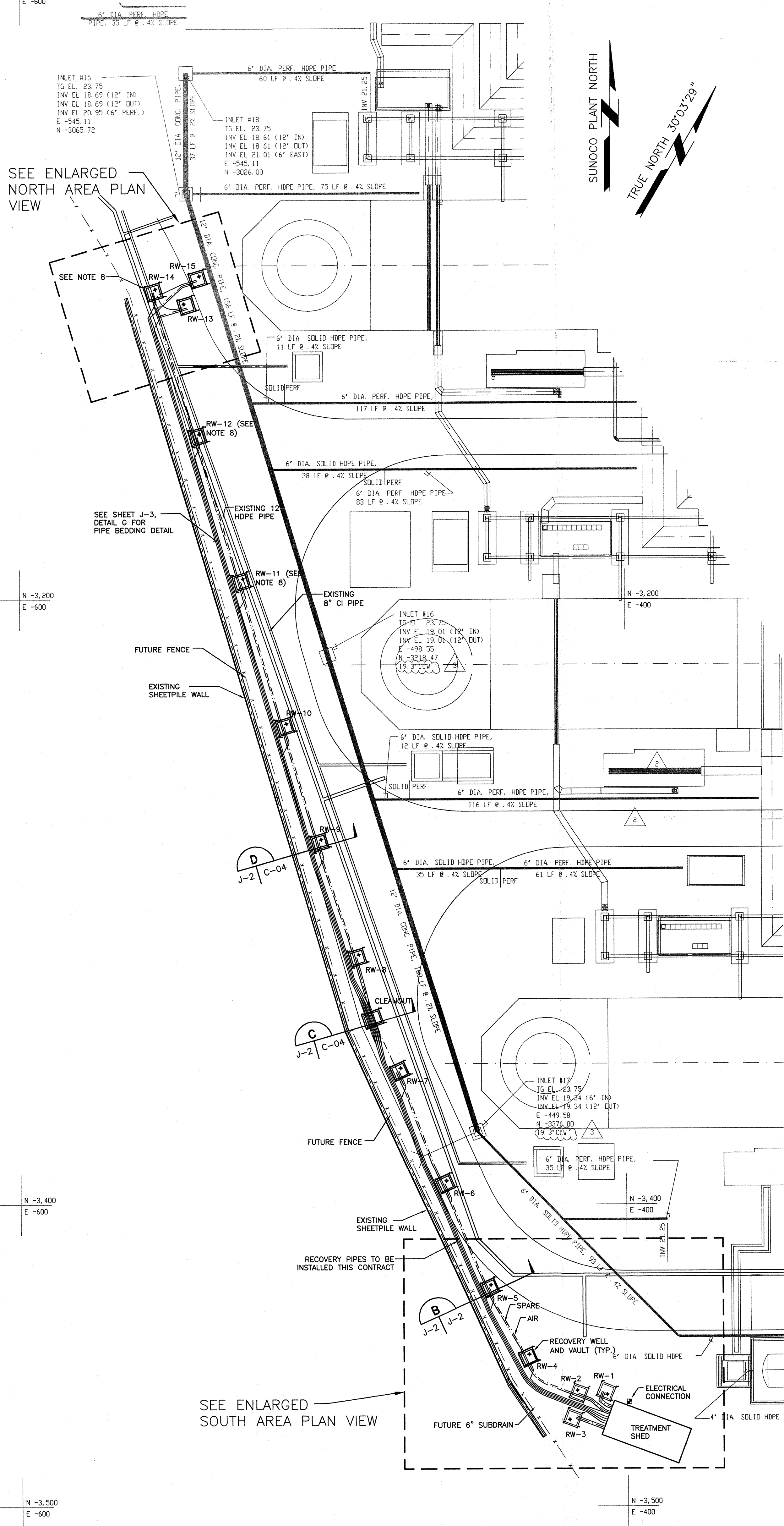
LOWER BUILDING EQUIPMENT LIST
-SUCTION MANIFOLD FOR RECOVERY WELLS
-DOUBLE DIAPHRAGM PUMP FOR RECOVERY WELLS
-DOUBLE DIAPHRAGM PUMP FOR TRENCH SUMPS
-AIR COMPRESSOR
-OIL/WATER SEPARATOR
-DIVERTER VALVE (WATER FROM UPPER BUILDING IS DIVERTED TO PROCESS SEWER IF LOWER SYSTEM IS SHUT DOWN BY ALARM CONDITIONS)

NOTES:

1. BASE DRAWING: STORM DRAINAGE & SANITARY SEWER PLAN; BY STONE & WEBSTER, INC., CHERRY HILL, NEW JERSEY; DRAWING # 13260-S5-EB-1C-3.
2. CONTRACTOR SHALL FIELD VERIFY ALL BURIED UTILITY LOCATIONS PRIOR TO COMMENCING CONSTRUCTION.
3. ELEVATIONS SHOWN ARE REFERENCED TO FPLE VERTICAL DATUM.



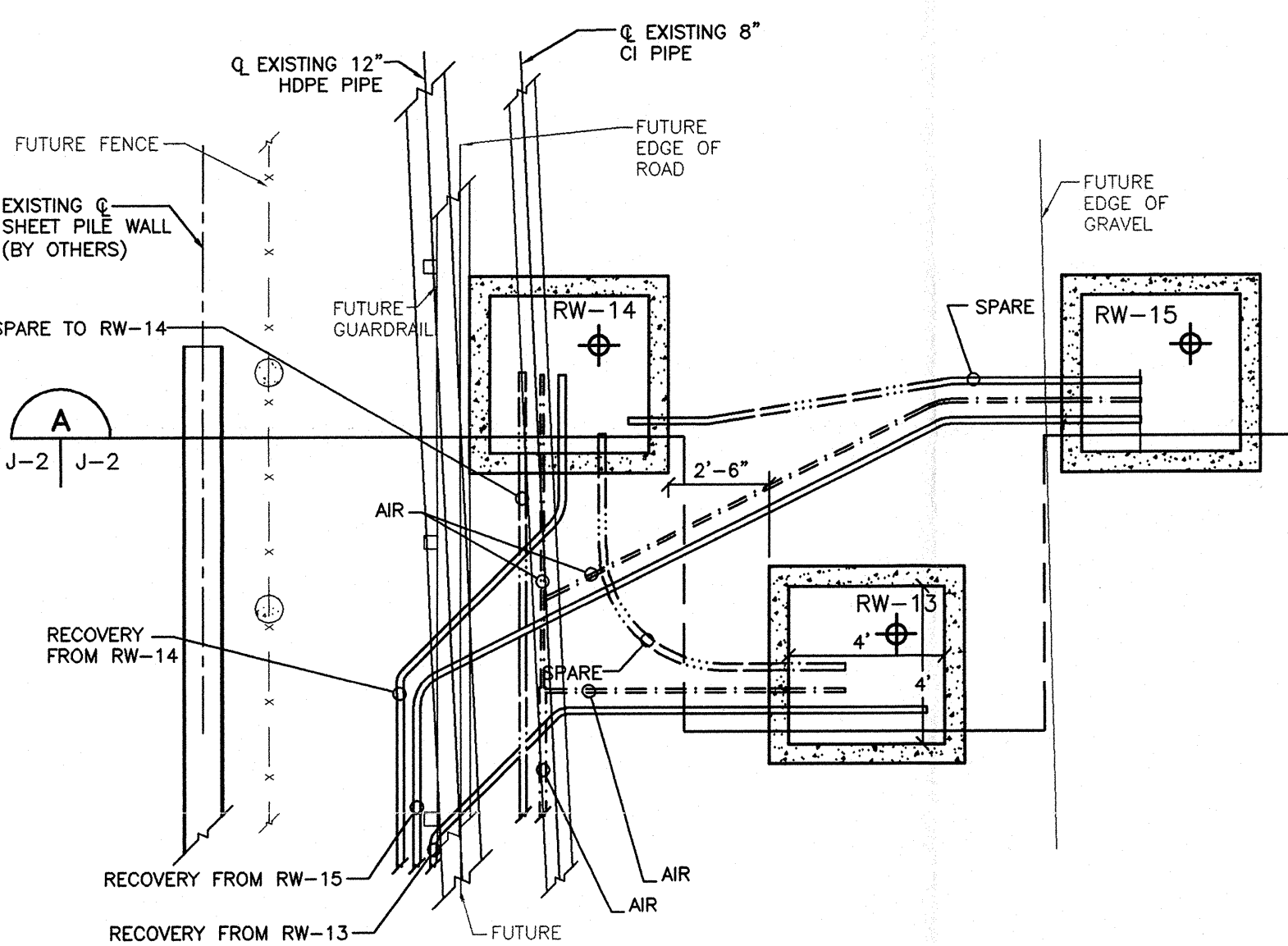
FILE			
LNAPL RECOVERY SYSTEM WELLS & EQUIPMENT/TREATMENT SHEDS			
PROJECT			
SUNOCO INC. (R&M)			
MARCUS HOOK, PENNSYLVANIA			
URS			
SCALE			
AS SHOWN	DATE	TBS	JOB NO.
12/09/04	DATE	GCA	19994641.00001
APP. BY			PIC. NO.
			J-1



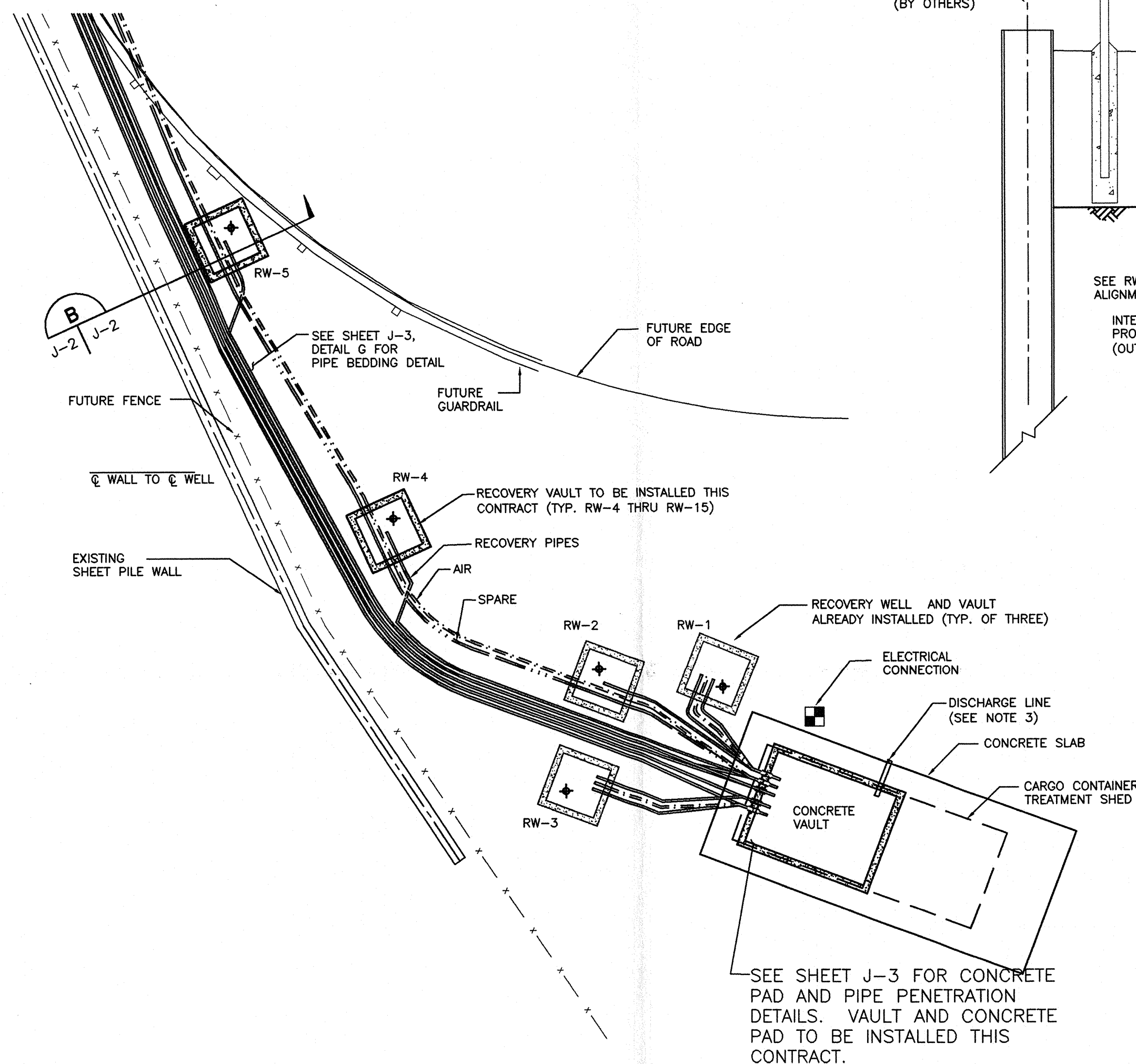
TOTAL FLUID RECOVERY SYSTEM SITE PLAN
SCALE: 1 INCH = 20 FEET

RECORD DRAWING:

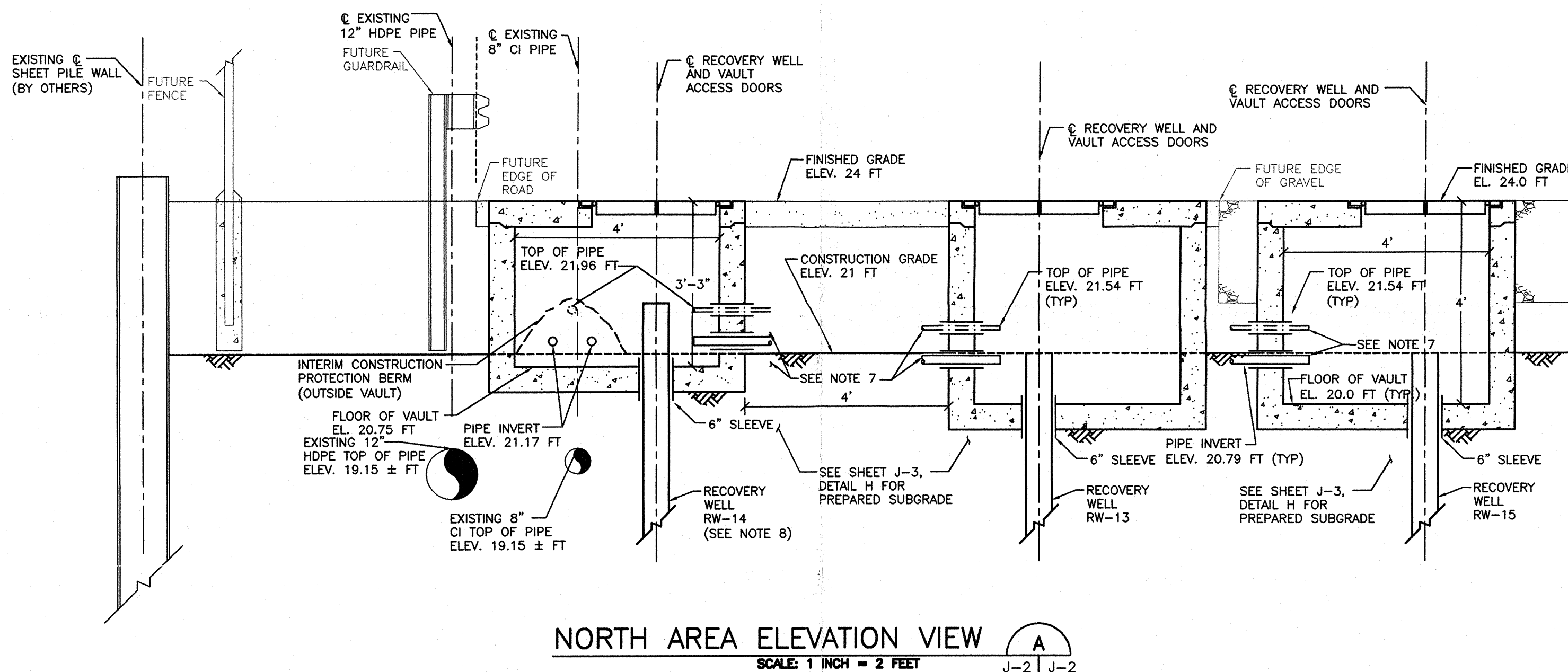
THE INSTALLATION AS SHOWN ON THIS RECORD DRAWING WAS NOT CONDUCTED WITH URS OVERSIGHT. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, URS CORPORATION CANNOT ASSURE ITS ACCURACY, AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THIS RECORD DRAWING OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO IT AS A RESULT. THOSE RELYING ON THIS RECORD DOCUMENT ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.



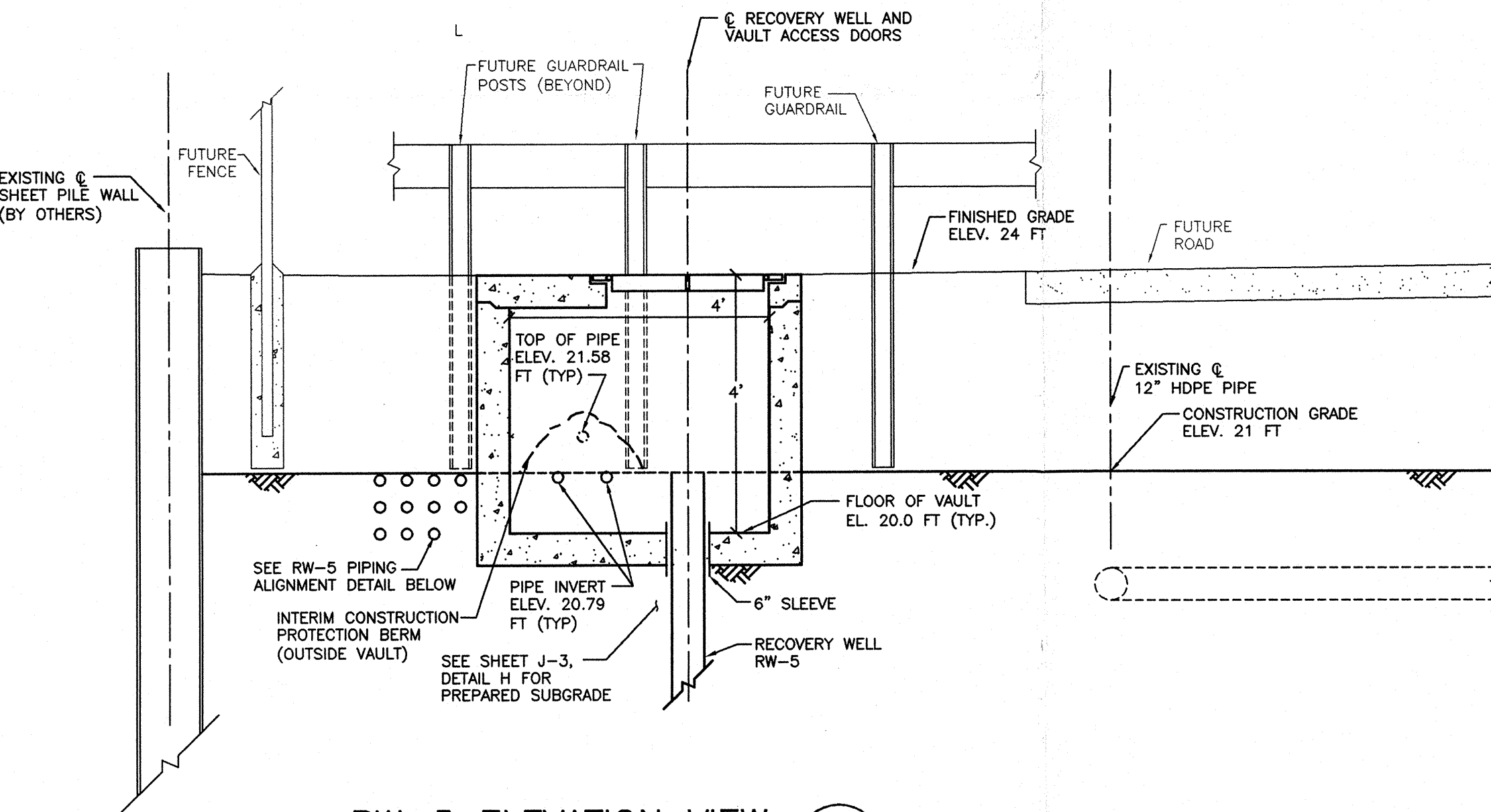
ENLARGED NORTH AREA PLAN VIEW
SCALE: 1 INCH = 4 FEET



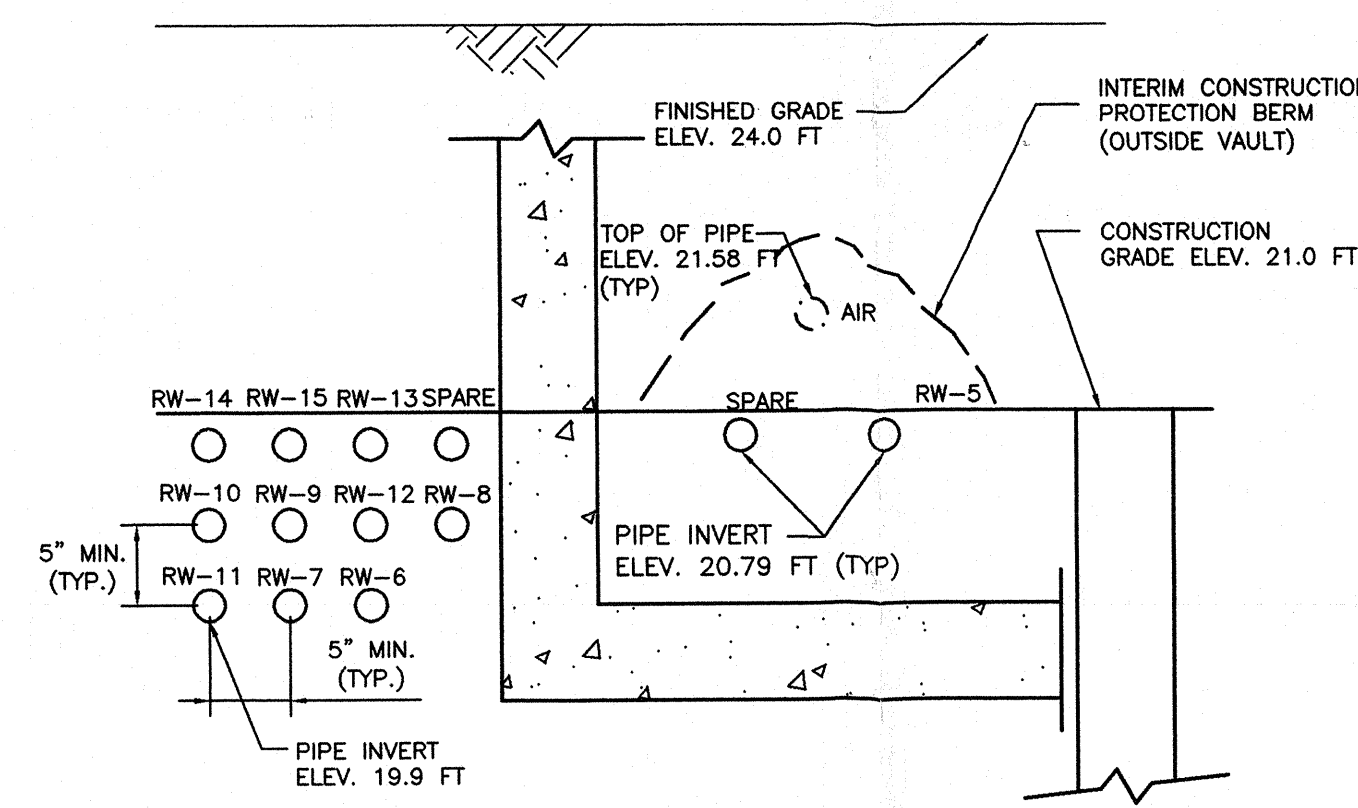
ENLARGED SOUTH AREA PLAN VIEW
SCALE: 1 INCH = 8 FEET



NORTH AREA ELEVATION VIEW
SCALE: 1 INCH = 2 FEET



RW-5 ELEVATION VIEW
SCALE: 1 INCH = 2 FEET



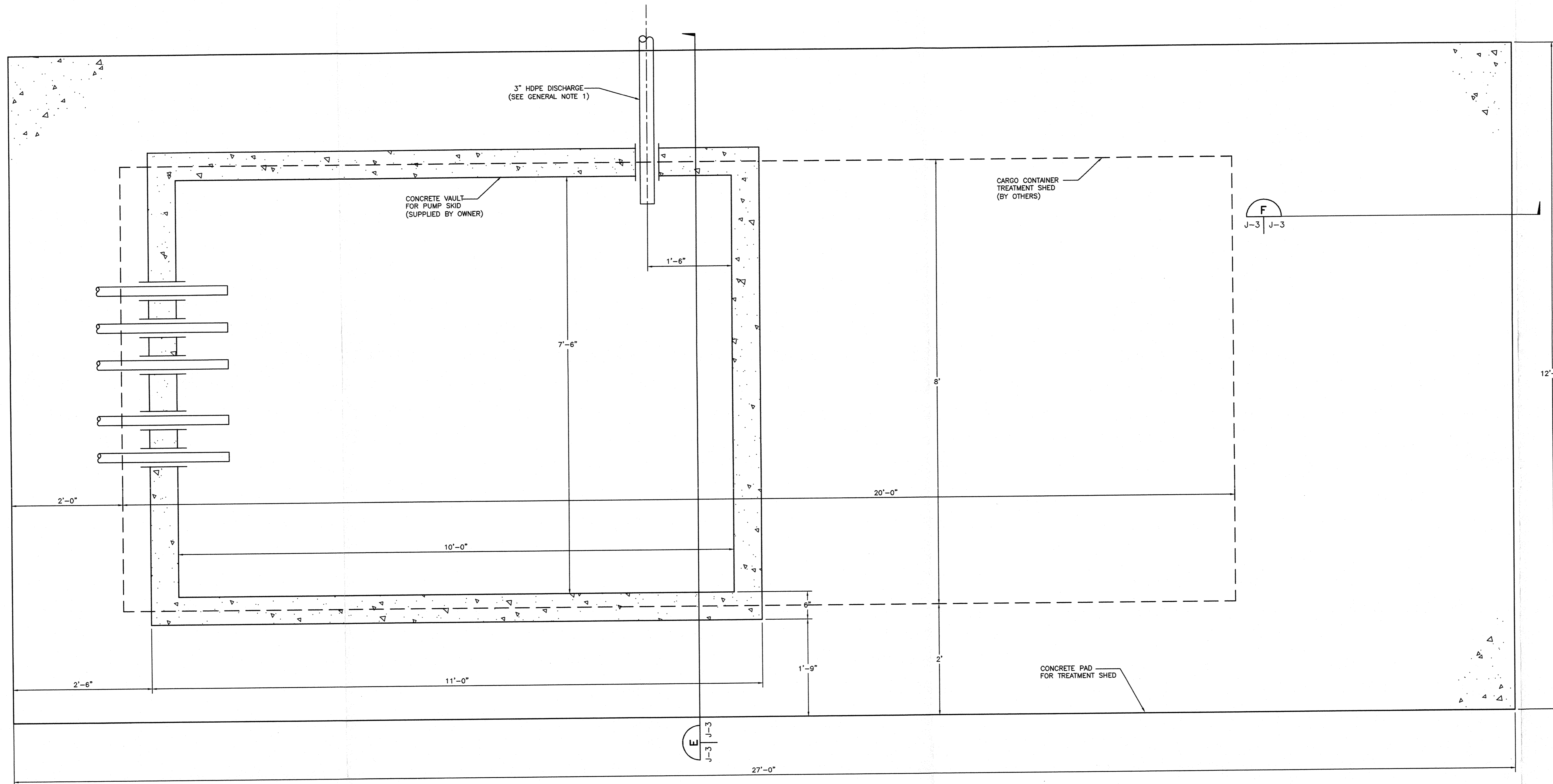
RW-5 PIPE ALIGNMENT DETAIL
NOT TO SCALE

NOTES:

1. BASE DRAWING: STORM DRAINAGE & SANITARY SEWER PLAN; BY STONE & WEBSTER, INC., CHERRY HILL, NEW JERSEY; DRAWING # 13260-S5-EB-1C-3.
2. CONTRACTOR SHALL FIELD VERIFY ALL BURIED UTILITY LOCATIONS PRIOR TO COMMENCING CONSTRUCTION.
3. DISCHARGE LINE TO BE INSTALLED BY OTHERS TO SUNOCO (R&M) SUMP 21A.
4. ALL PIPING SHALL BE 2" HDPE UNLESS SHOWN OTHERWISE.
5. RECOVERY WELLS TO BE INSTALLED BY OTHERS. CONCRETE VAULTS AND ACCESS DOORS ARE TO BE SUPPLIED BY OWNER, AND INSTALLED UNDER THIS CONTRACT.
6. ELECTRICAL POWER FOR RECOVERY SYSTEM OPERATION TO BE SUPPLIED BY OWNER.
7. BURIED PIPING BETWEEN MANHOLES NOT SHOWN FOR CLARITY.
8. INSTALL 3'-9" OUTSIDE HEIGHT PRECAST VAULTS AT RW-11, RW-12 AND RW-14 LOCATIONS. ALL OTHER VAULTS ARE 4'-6" OUTSIDE HEIGHT UNLESS OTHERWISE NOTED.
9. VAULTS RW-4 THROUGH RW-15 TO BE ORIENTATED PARALLEL WITH ALIGNMENT OF EXISTING SHEETPILE WALL. VAULTS RW-1, RW-2 AND RW-3 TO BE ORIENTATED PARALLEL TO CONCRETE SLAB FOR TREATMENT SHED.
10. ALL RECOVERY WELLS SHALL PENETRATE THE BOTTOM OF THE ACCESS VAULT IN THE NORTHEAST CORNER OF THE VAULT. LIDS TO BE INSTALLED ORIENTED AS SHOWN.
11. ELEVATIONS SHOWN ARE REFERENCED TO FPLE VERTICAL DATUM.

LEGEND:

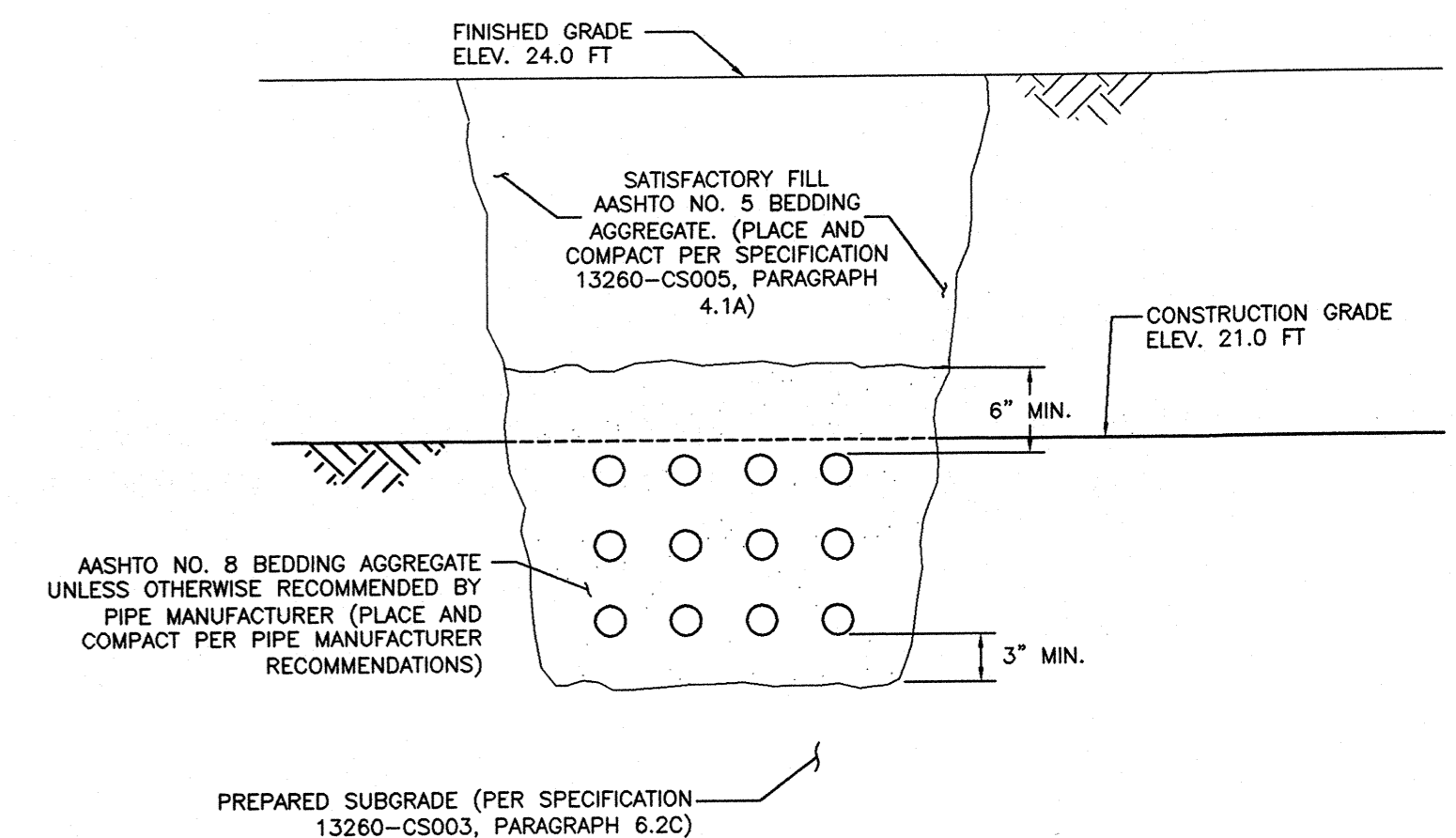
- RECOVERY LINE
- AIR LINE
- SPARE LINE
- FUTURE FENCE



TOTAL FLUIDS RECOVERY SYSTEM CONCRETE PAD
SCALE: 1/4" = 1' 0"

RECORD DRAWING:

THE INSTALLATION AS SHOWN ON THIS RECORD DRAWING WAS NOT CONDUCTED WITH URS OVERSIGHT. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, URS CORPORATION CANNOT ASSURE ITS ACCURACY, AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THIS RECORD DRAWING OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO IT AS A RESULT. THOSE RELYING ON THIS RECORD DOCUMENT ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.



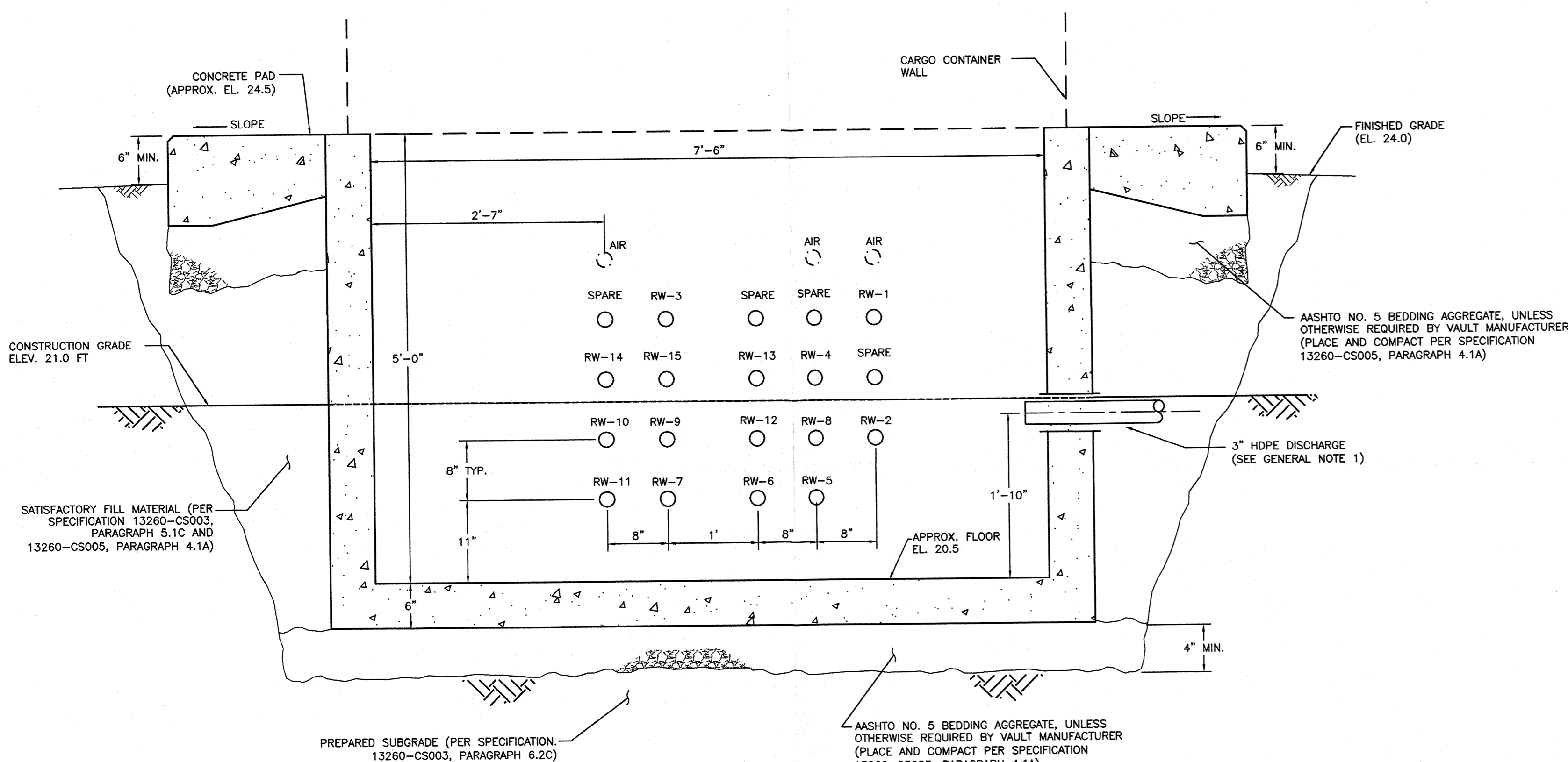
PIPE BEDDING DETAIL
NOT TO SCALE

GENERAL NOTES:

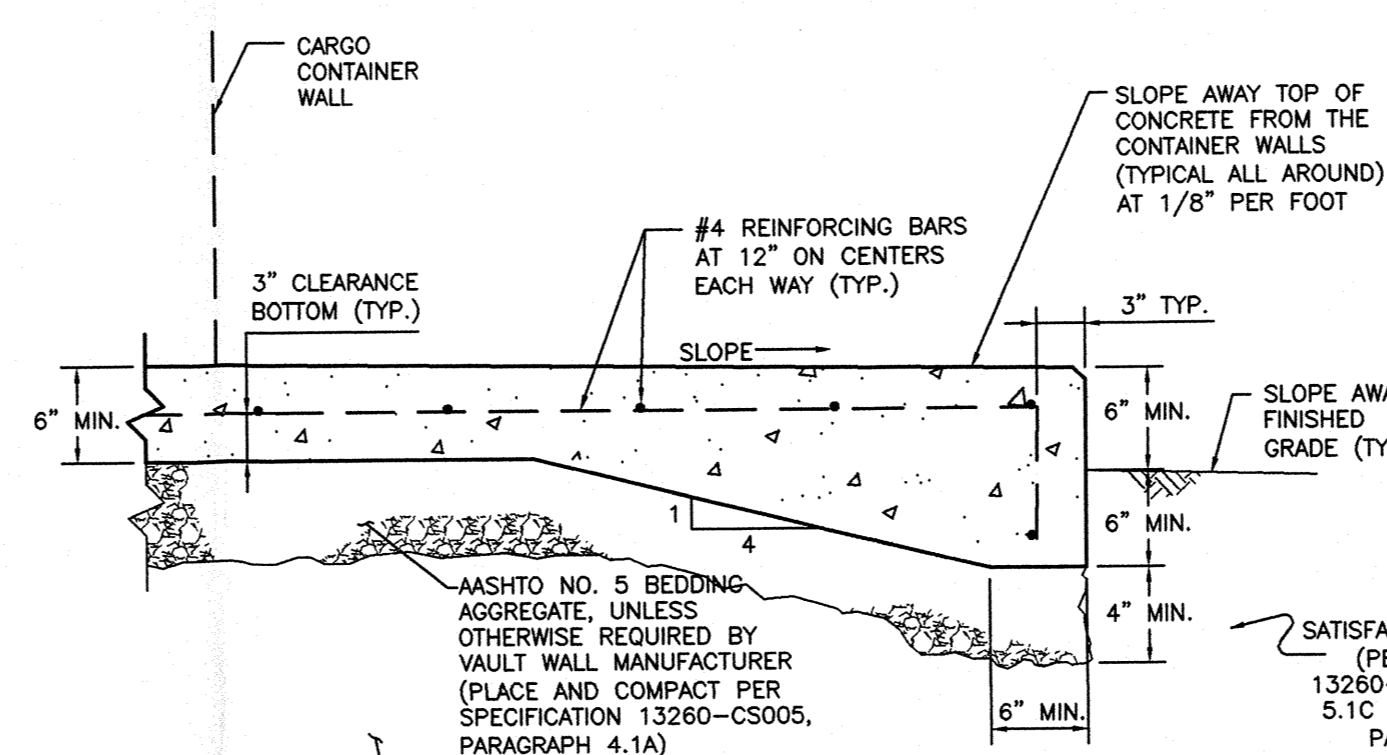
- DISCHARGE LINE TO BE INSTALLED BY OTHERS TO SUNOCO (R&M) SUMP 21A.
- ALL PIPING SHALL BE 2" HDPE UNLESS SHOWN OTHERWISE.
- CONSTRUCTION SEQUENCE:
 - LOCATE PLAN-VIEW POSITION OF STEEL PROTECTIVE PLATE.
 - EXCAVATE TO DEPTH OF STEEL LOCATOR PLATE.
 - EXCAVATE TO DEPTH OF STEEL WELL PROTECTOR USING HAND TOOLS OR SOFT-DIG TECHNIQUES.
 - CONTINUE EXCAVATION TO ACCOMMODATE PLACEMENT OF RECOVERY WELL VAULT TO LINES AND GRADES AS INDICATED.
 - INSTALL BEDDING AGGREGATE, VAULT AND BACKFILL AS INDICATED.

LEGEND:

- RECOVERY LINE
- AIR LINE
- SPARE LINE



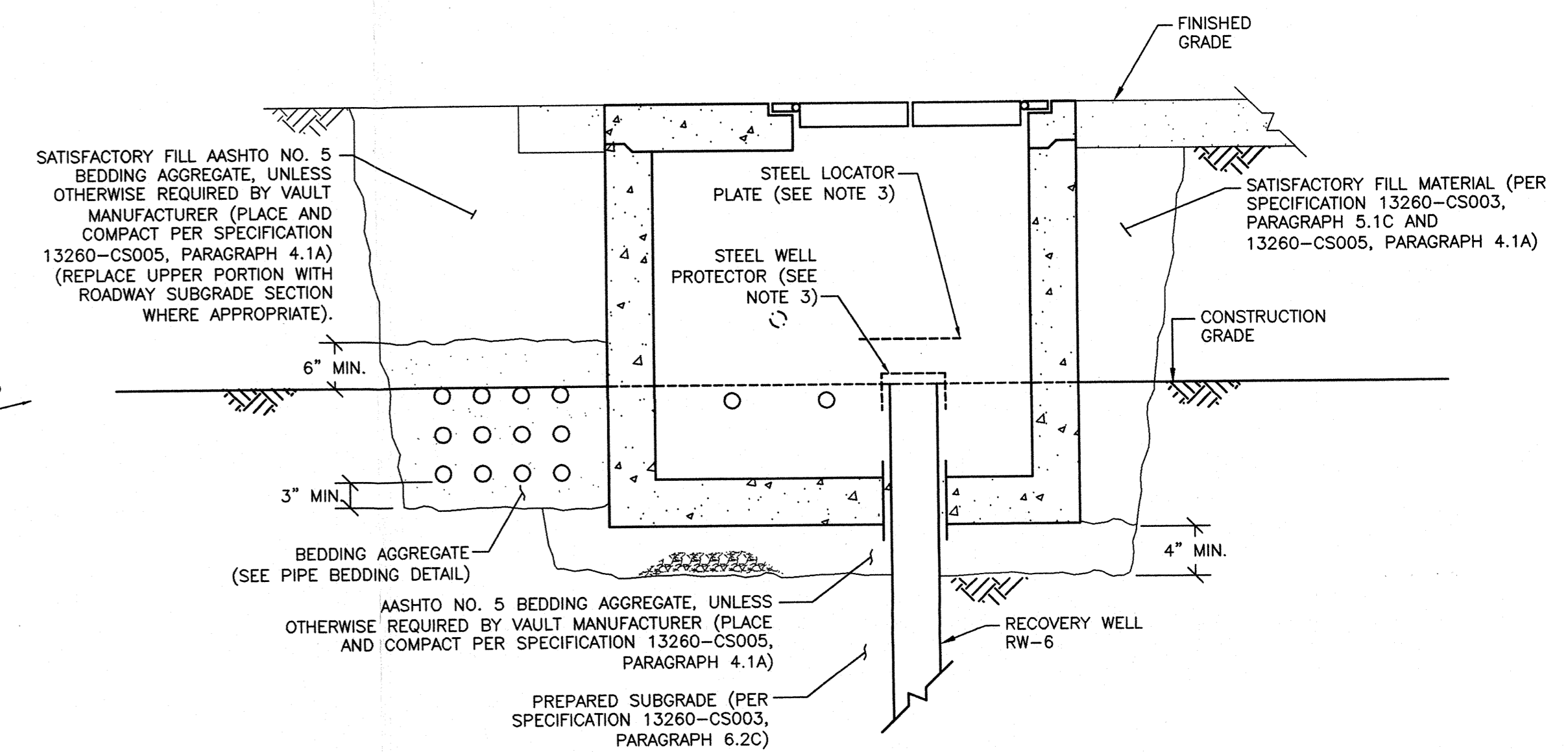
VAULT PENETRATION ELEVATION VIEW
NOT TO SCALE



STRUCTURAL (TYPICAL) DETAIL
NOT TO SCALE

CONCRETE PAD NOTES:

- ALL CONCRETE WORK SHALL COMPLY WITH THE REQUIREMENTS OF THE AMERICAN CONCRETE INSTITUTE (ACI) 301, 304, 305, 306 AND 318.
- ALL CONCRETE SHALL HAVE A MINIMUM COMPRESSIVE STRENGTH OF 4000 PSI AT 28 DAYS.
- REINFORCING BARS FOR CONCRETE WORK SHALL BE PER REQUIREMENTS OF THE AMERICAN SOCIETY FOR TESTING OF MATERIALS (ASTM) A615 GRADE 60, DEFORMED.
- ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4" CHAMFER.
- ALL BAR SPLICES SHALL BE CLASS B TENSION LAP.
- PROOF-ROLL EXPOSED SUBGRADE WITH LOADED TRIAXLE DUMP, MIN. 10-TON SMOOTH-DRUM ROLLER, OR OTHER COMPACTION EQUIPMENT APPROVED BY THE OWNER. EXCAVATE SOFT SOILS OR YIELDING AREAS AND REPLACE WITH COMPACTED STRUCTURAL FILL. COMPACT TO AT LEAST 92% MODIFIED PROCTOR MAXIMUM DRY DENSITY (PER ASTM D1557).



PREPARED SUBGRADE DETAIL
NOT TO SCALE

SEND TO PHONE
FILE
SCALE: 1/4" = 1' 0"
DATE: 07/03/02
PROJECT: 24-25995049.00
TASK: 0001
PROJ: 0001

REV	DESCRIPTION OF REVISION	BY	DATE
1	ADDED ELEVATION NOTATIONS		8/5/02
2	ISSUED FOR CONSTRUCTION		07/03/02



URS

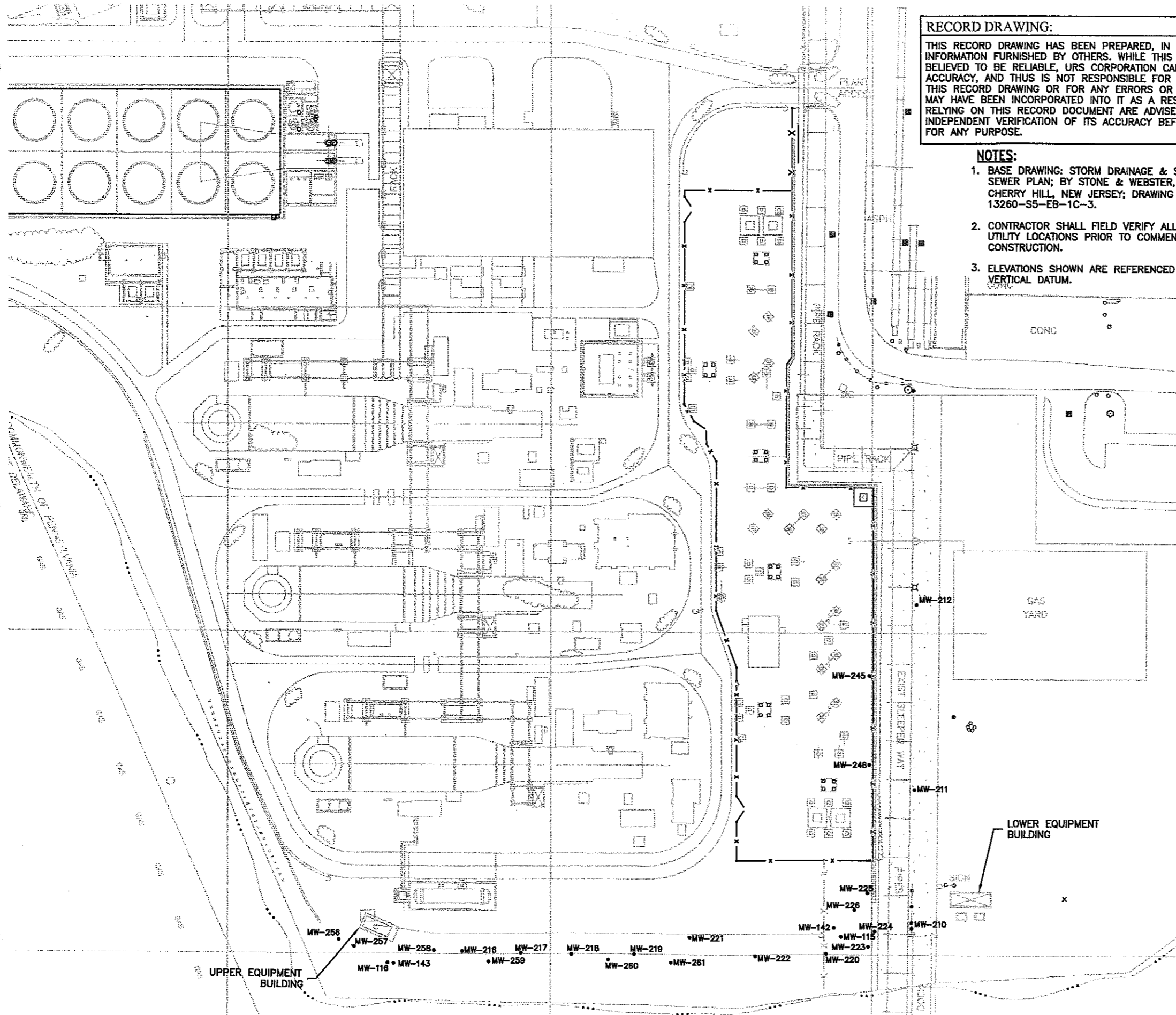
1400 Union Meeting Road
Blue Bell, Pennsylvania 19422-1972

WARNING
0 3 1
IF THIS BAR DOES NOT MEASURE 1" THEN DRAWING IS NOT TO SCALE.

DESIGNED JF
DRAWN DD
CHECKED JC
PEER REVIEWED
PROJECT MANAGER
DATE

SUNOCO INC. (R&M) MARCUS HOOK, PENNSYLVANIA
WEST CUT-OFF WALL
TOTAL FLUIDS RECOVERY SYSTEM
CONCRETE PAD AND DETAILS

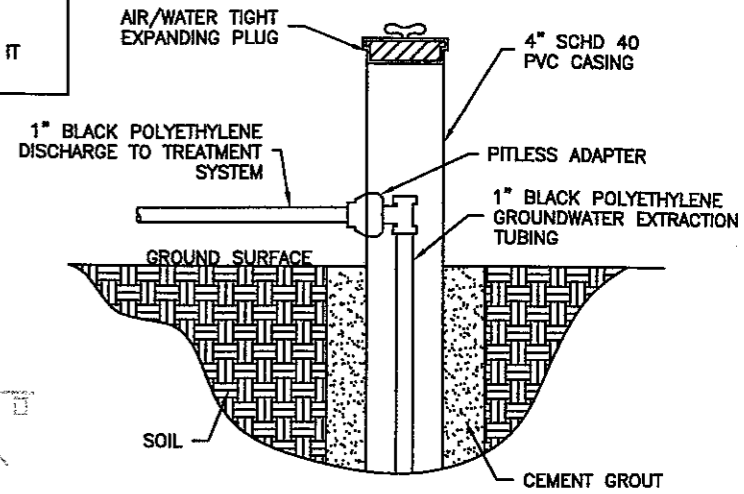
REVISION
PROJECT 24-25995049.00
DRAWING
J-3
SHEET OF



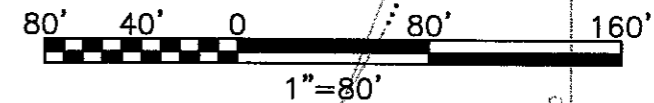
RECORD DRAWING:

THIS RECORD DRAWING HAS BEEN PREPARED, IN PART, BASED UPON INFORMATION FURNISHED BY OTHERS. WHILE THIS INFORMATION IS BELIEVED TO BE RELIABLE, URS CORPORATION CANNOT ASSURE ITS ACCURACY, AND THUS IS NOT RESPONSIBLE FOR THE ACCURACY OF THIS RECORD DRAWING OR FOR ANY ERRORS OR OMISSIONS WHICH MAY HAVE BEEN INCORPORATED INTO IT AS A RESULT. THOSE RELYING ON THIS RECORD DOCUMENT ARE ADVISED TO OBTAIN INDEPENDENT VERIFICATION OF ITS ACCURACY BEFORE APPLYING IT FOR ANY PURPOSE.

- NOTES:**
1. BASE DRAWING: STORM DRAINAGE & SANITARY SEWER PLAN; BY STONE & WEBSTER, INC., CHERRY HILL, NEW JERSEY; DRAWING # 13260-S5-EB-1C-3.
 2. CONTRACTOR SHALL FIELD VERIFY ALL BURIED UTILITY LOCATIONS PRIOR TO COMMENCING CONSTRUCTION.
 3. ELEVATIONS SHOWN ARE REFERENCED TO FPLE VERTICAL DATUM.

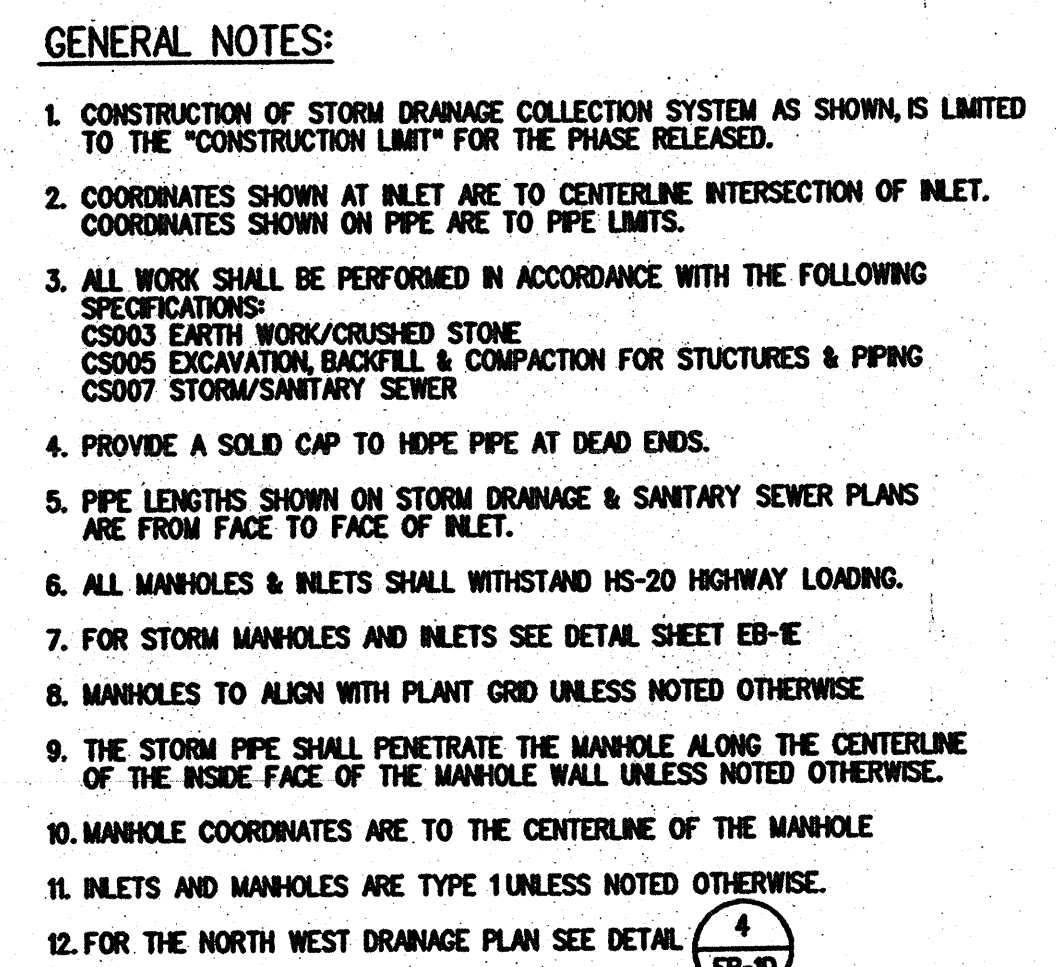











WELL HEAD DETAIL
NTS



TITLE SOUTHERN & EASTERN RECOVERY WELLS & WELL HEAD DETAIL			
PROJECT SUNOCO INC. (R&M) MARCUS HOOK, PENNSYLVANIA			
URS			
SCALE AS NOTED	DWN. BY TBS	JOB NO. 19994641.00001	
DATE 12/09/04	APPR. BY GCA	FIG. NO. J-4	

Appendix K
Stormwater Control System



	STATE LINE
	EASEMENT LINE
	LEASE LINE
	CENTER LINE
	EXISTING STRUCTURE
	EXISTING GAS LINE
	EXISTING FENCE LINE
	PROPOSED ROADWAY
	PROPOSED STRUCTURE

BLDG.	BUILDING
COW	COUNTER CLOCKWISE
CVC	CENTER TO CENTER
CL	CENTERLINE
CLR.	CLEAR
CONC	CONCRETE
CW.	CLOCKWISE
DIA.	DIAMETER
DWG.	DRAWING
E	EASTING
EL.	ELEVATION
GALV.	GALVANIZED
HDPE	HIGH DENSITY POLYETHYLENE
INV	INVERT
LF	LINEAR FEET
MAX.	MAXIMUM
MH	MANHOLE
MIN.	MINIMUM
N	NORTHING
NTS	NOT TO SCALE
O.C.	ON CENTER
OD	OUTER DIAMETER
PERF.	PERFORATED
PVCP	POLYVINYL CHLORIDE PIPE
RCP	REINFORCED CONCRETE PIPE
SQ.	SQUARE
STL.	STEEL
SWYO	SWITCH YARD
TG	TOP OF GRATE
TYP	TYPICAL
W/	WITH

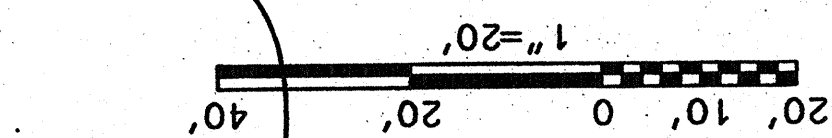
FOR AMMONIA STORAGE STRUCTURAL, SEE DRAWING EC-22B
FOR EXCITATION TRANSFORMER STRUCTURAL, SEE DRAWING EC-21B



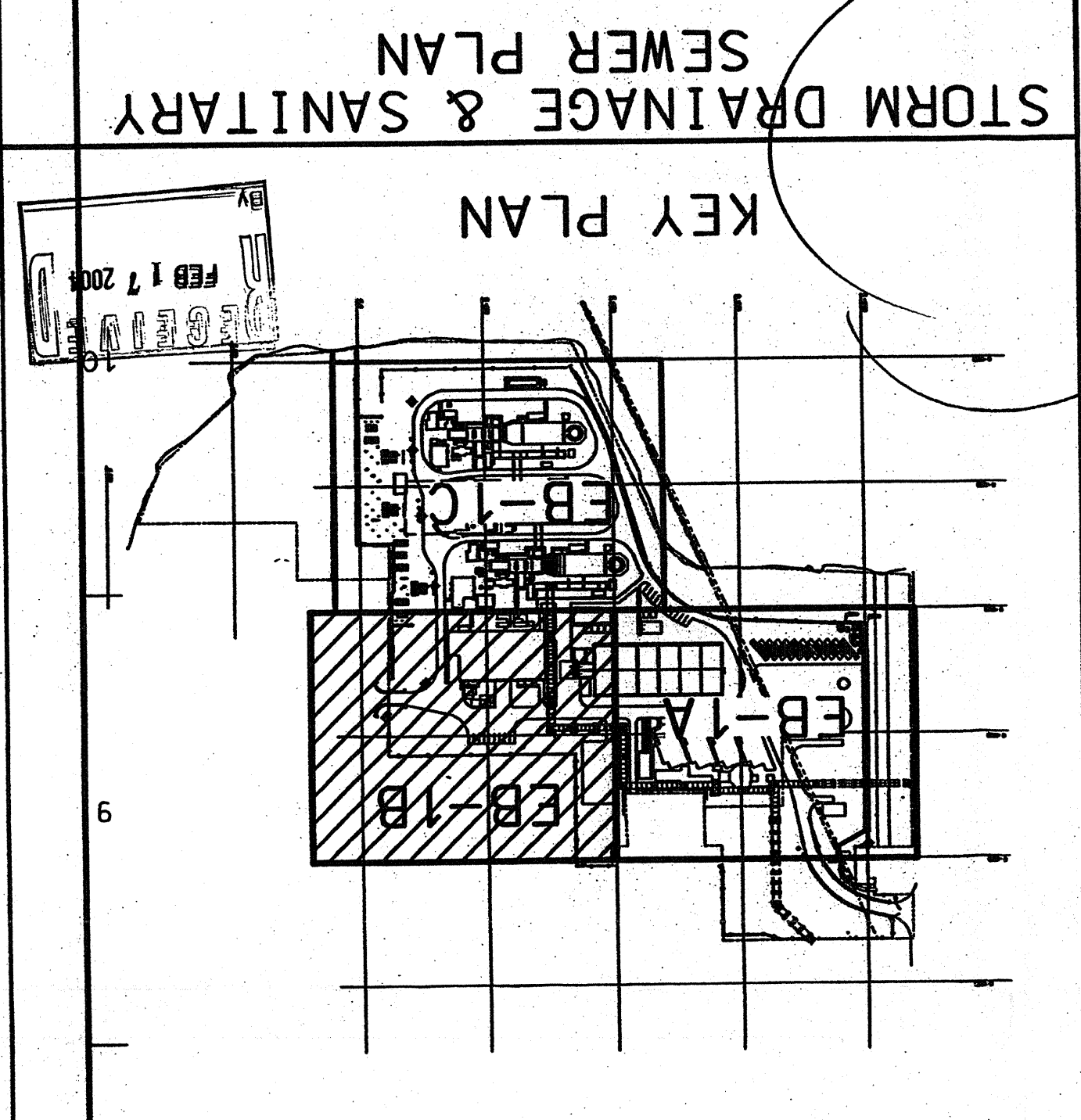
FPL ENERGY MARCUS HOOK, L.P.
MARCUS HOOK, PENNSYLVANIA

DESIGNED BY:MS	DRAWN BY:TCP
DESIGN CHKD BY:AR	CHKD BY: AR

[illegible]

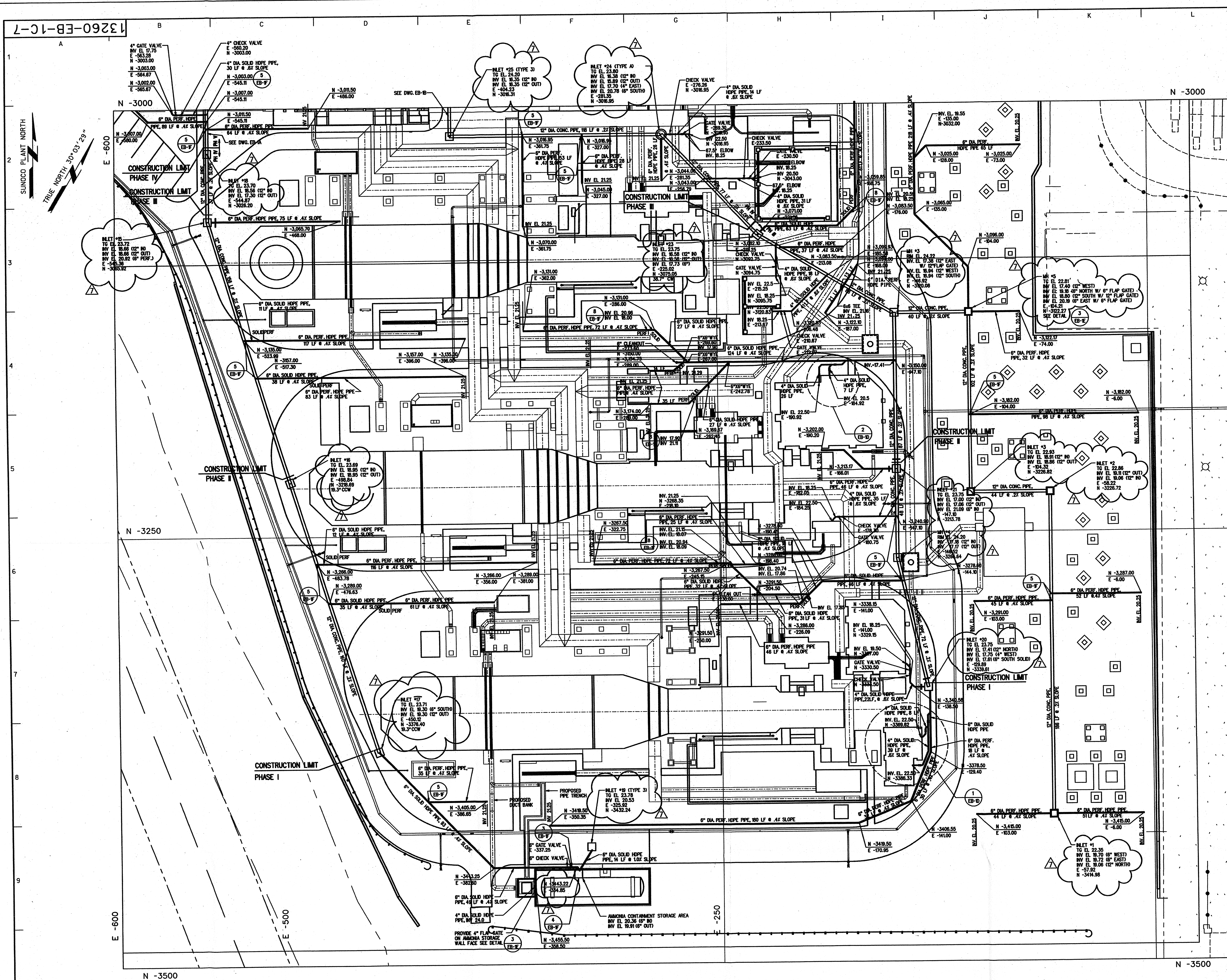


1. FOR GENERAL NOTES REFER TO DRAWING NO. 13260-EB-1A



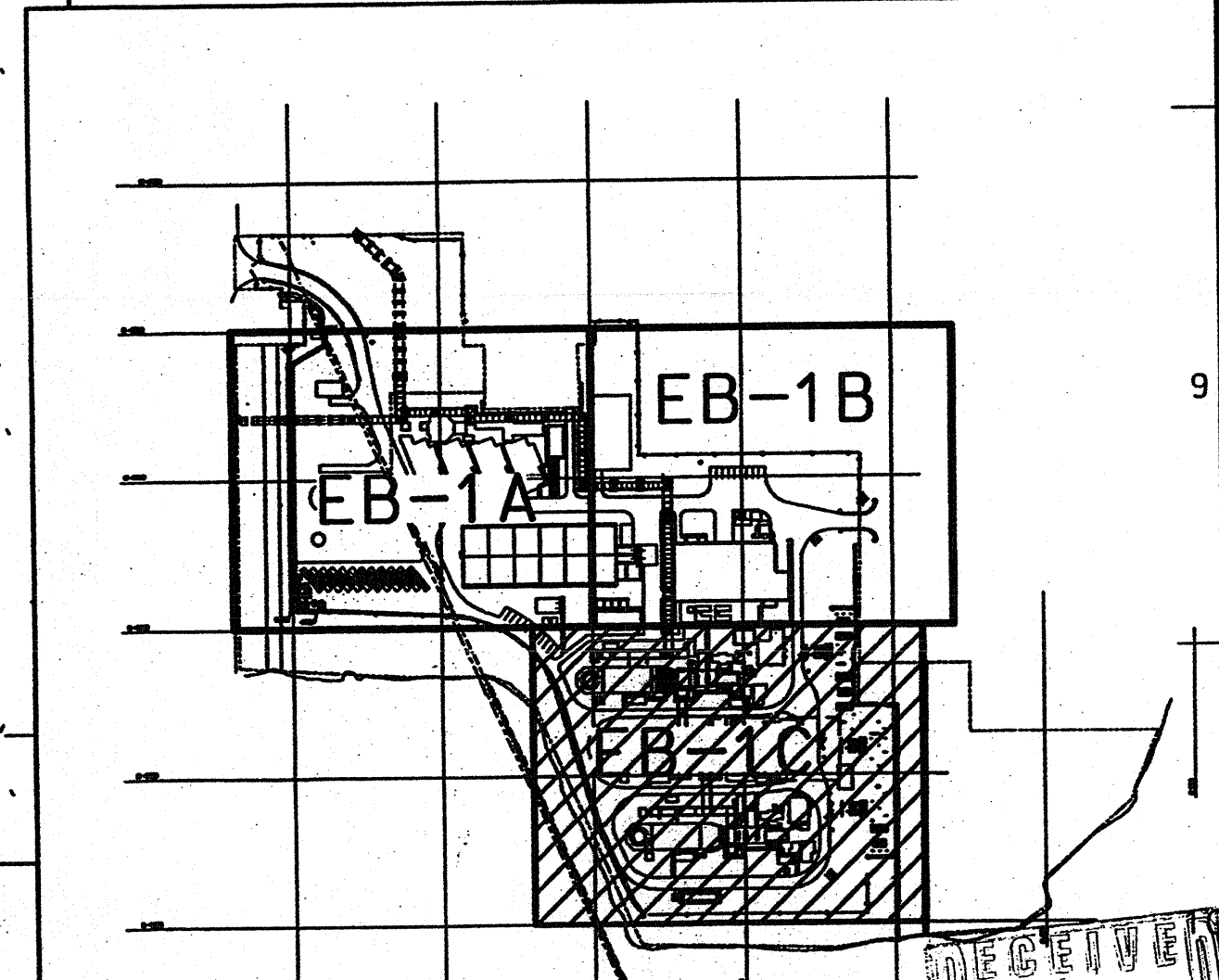
STORM DRAINAGE & SANITARY
SEWER PLAN

[illegible]




NOTES:

1. FOR GENERAL NOTES AND LEGEND REFER TO DRAWING NO 13260-EB-1A




KEY PLAN

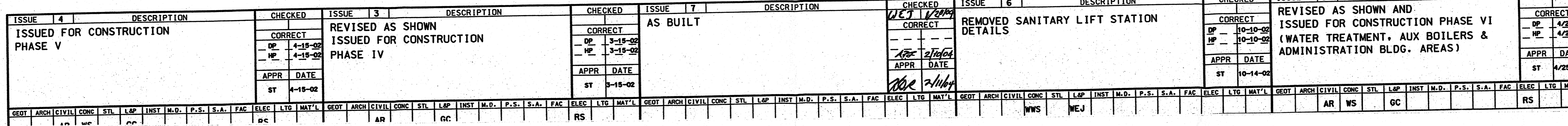
STORM DRAINAGE & SANITARY
SEWER PLAN

 **FPL ENERGY** MARCUS HOOK, L.P.
MARCUS HOOK, PENNSYLVANIA

STONE & WEBSTER, INC.
CHERRY HILL, NJ.

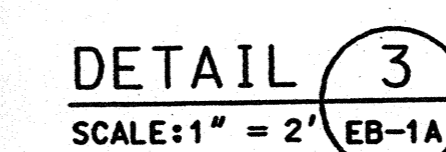
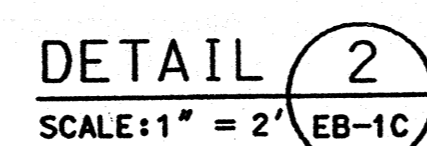
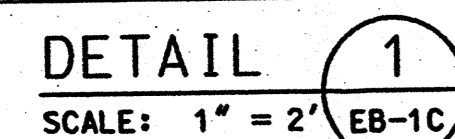
 DRAWING 13260-EB-1C-7

[illegible]



TYPE	COMMENTS
A	NO PERFORATIONS
B	WITH PERFORATIONS

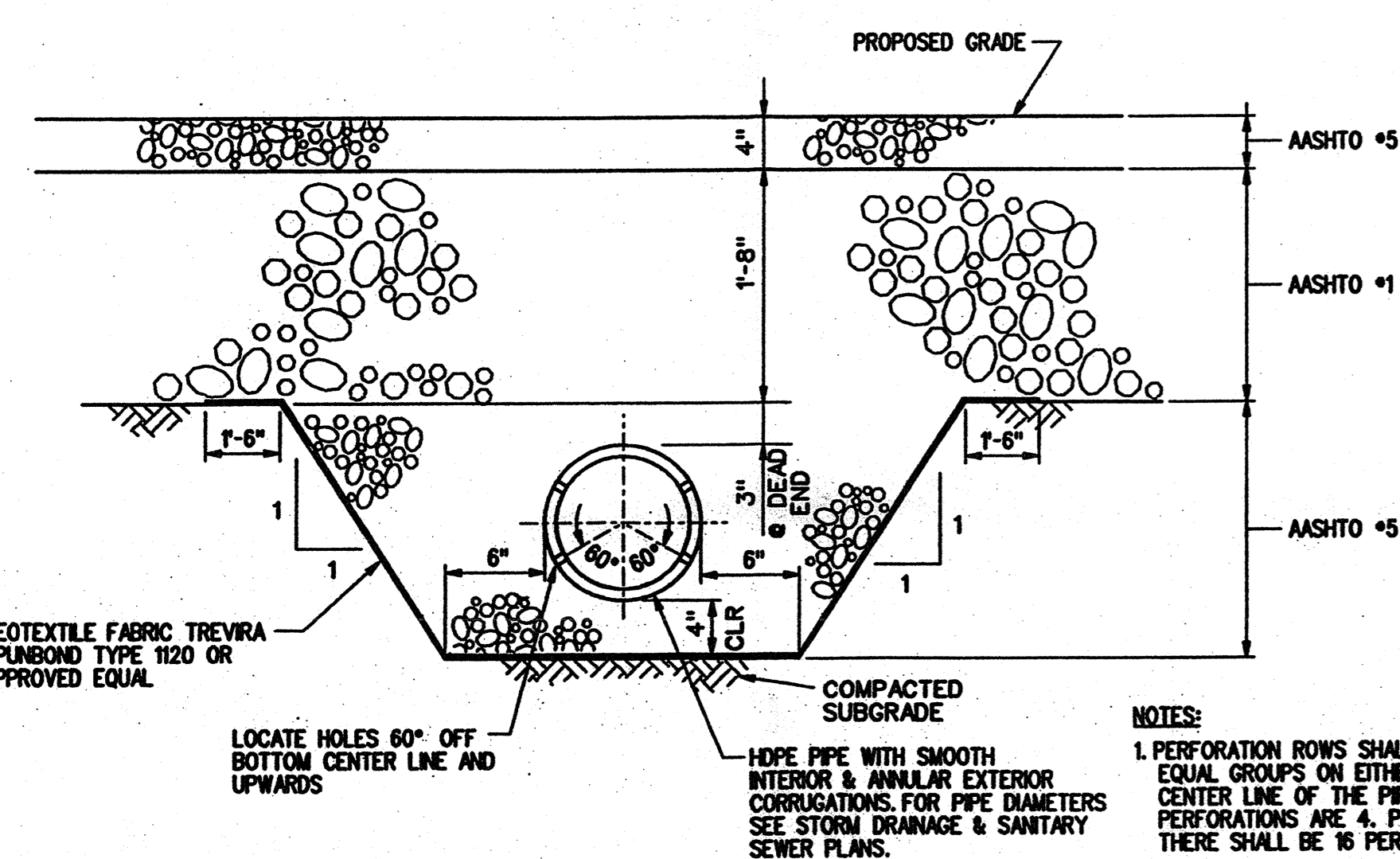
RESP. ENGR:



- STORM SEWER

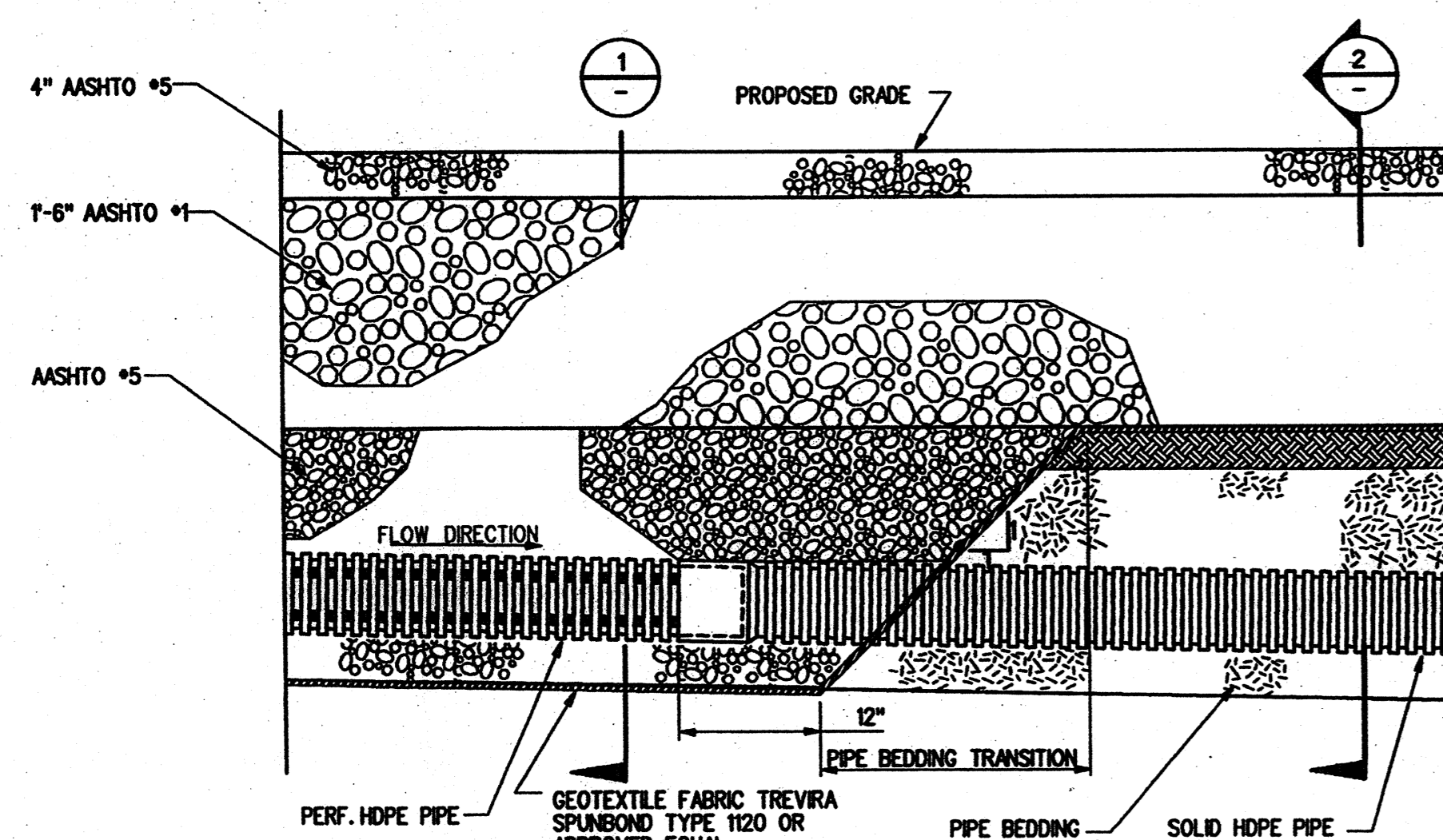
DESIGNED BY:MS	DRAWN BY:TCP
DESIGN CHKD BY:AR	CHKD BY: AR

RESP ENGR:

TYPICAL SECTION FOR
PERFORATED HDPE DRAIN PIPE

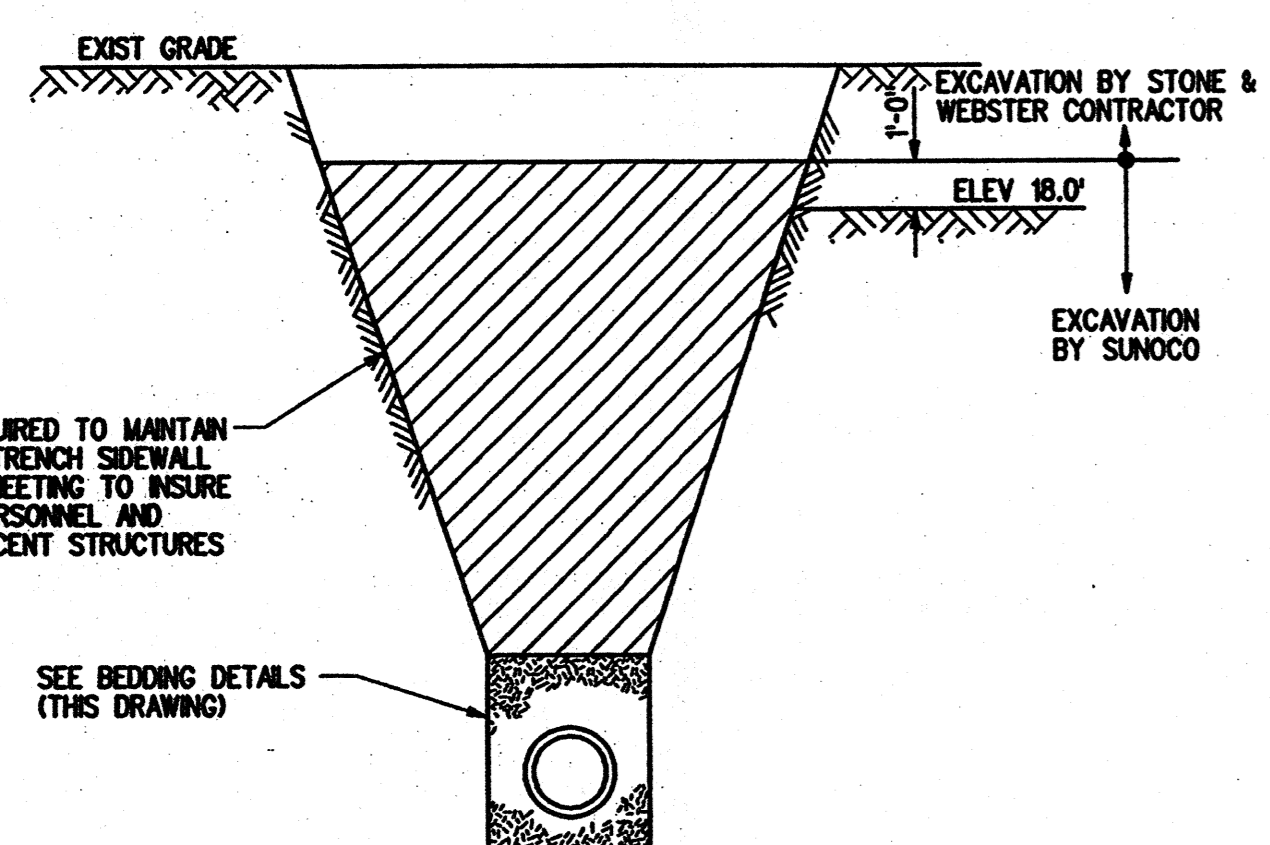
NTS

1

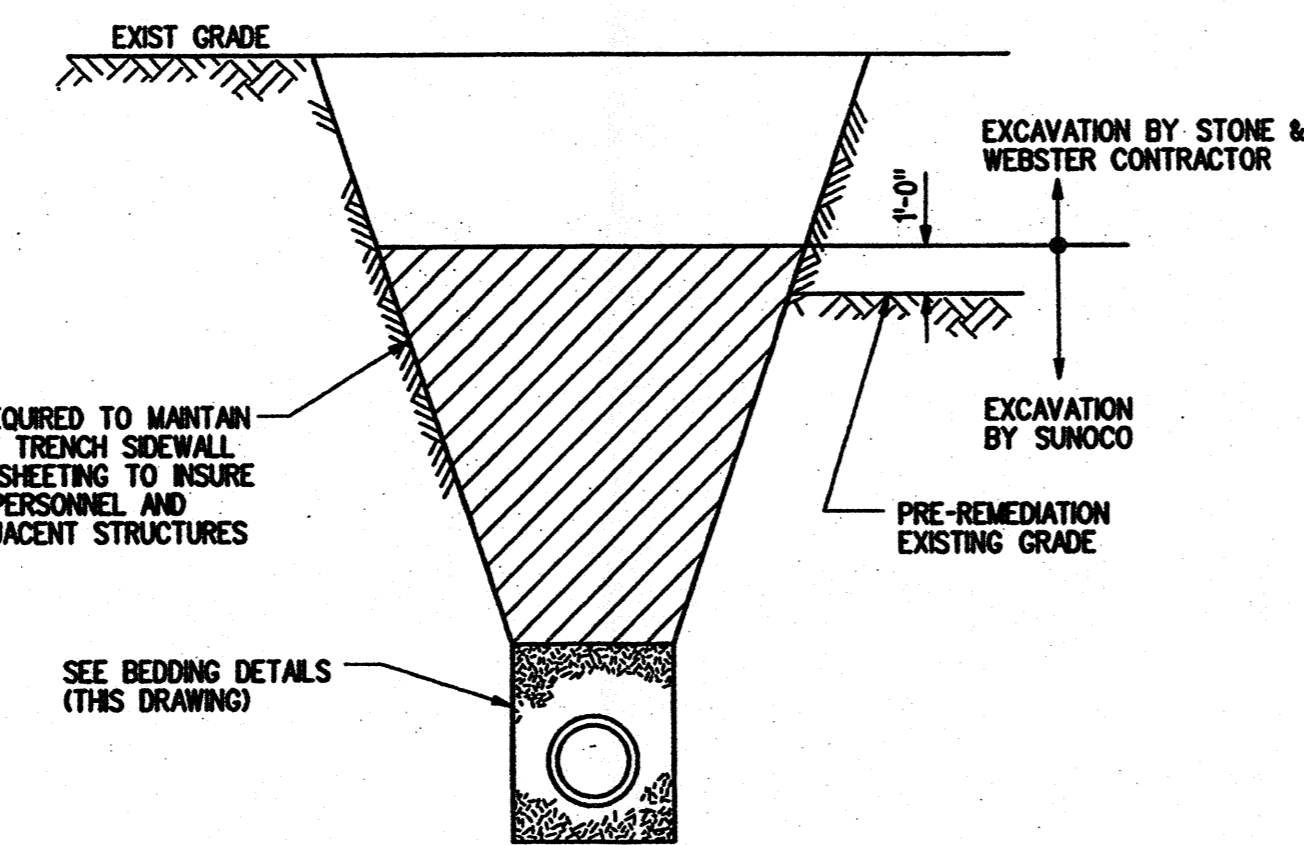
EB-1A
EB-1B
EB-1CTYPICAL VIEW FOR
PERF. TO SOLID HDPE PIPE

NTS

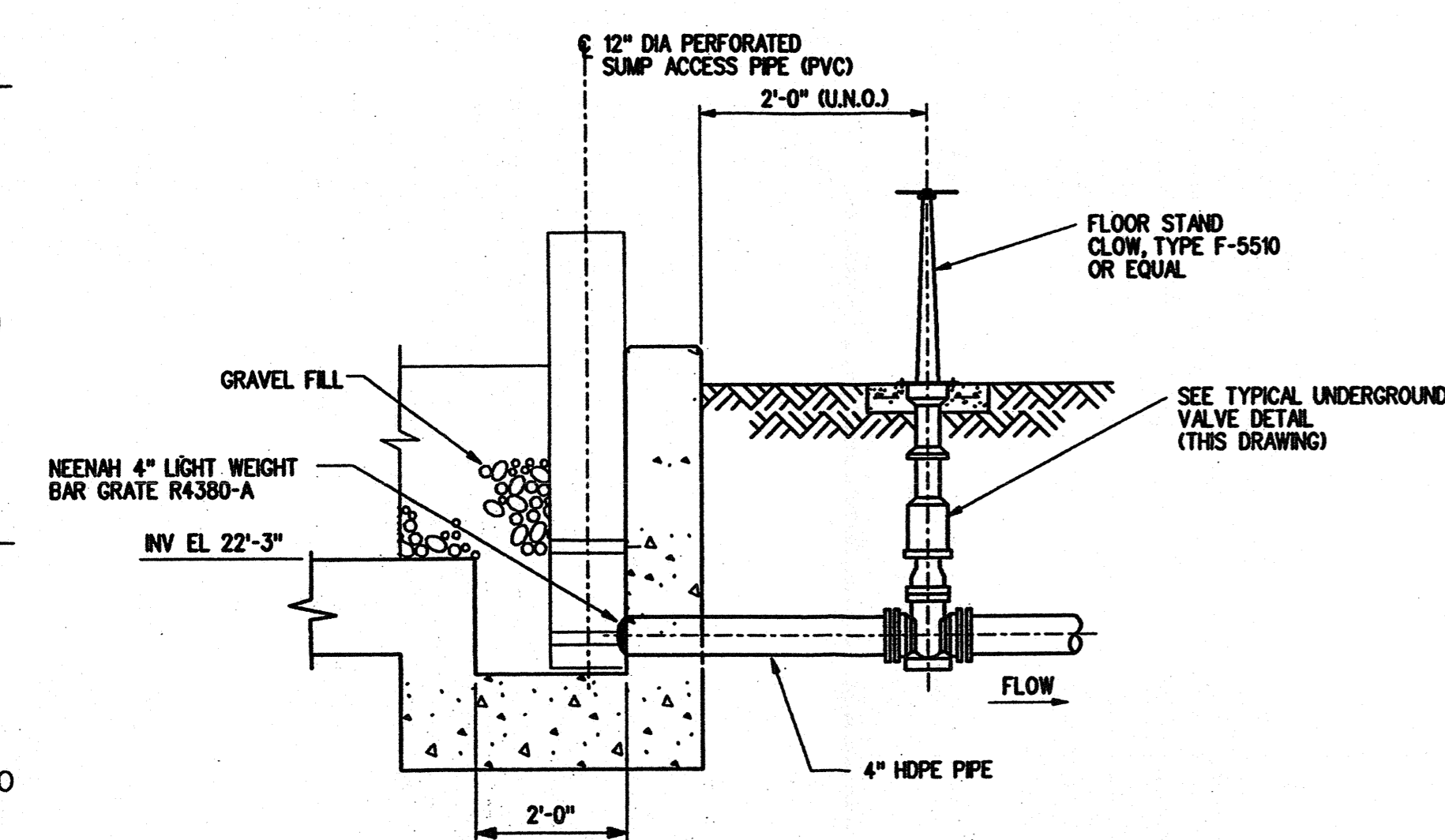
11

EB-1A
EB-1B
EB-1CTYPICAL EXCAVATION DETAIL
COMMONWEALTH OF PENNSYLVANIA

NTS

TYPICAL EXCAVATION DETAIL
STATE OF DELAWARE

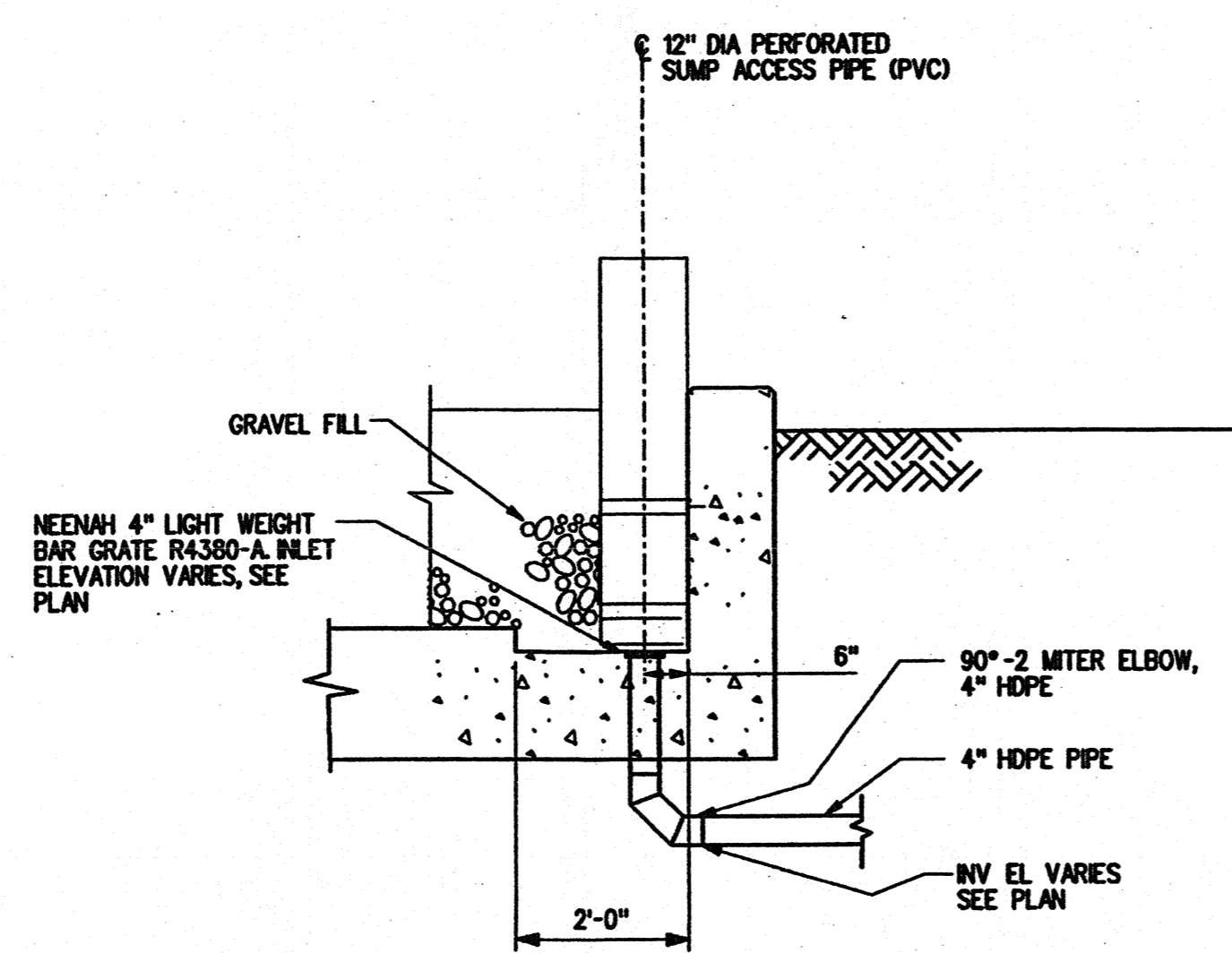
NTS



TYPICAL TRANSFORMER SUMP DETAIL

NOT TO SCALE

6

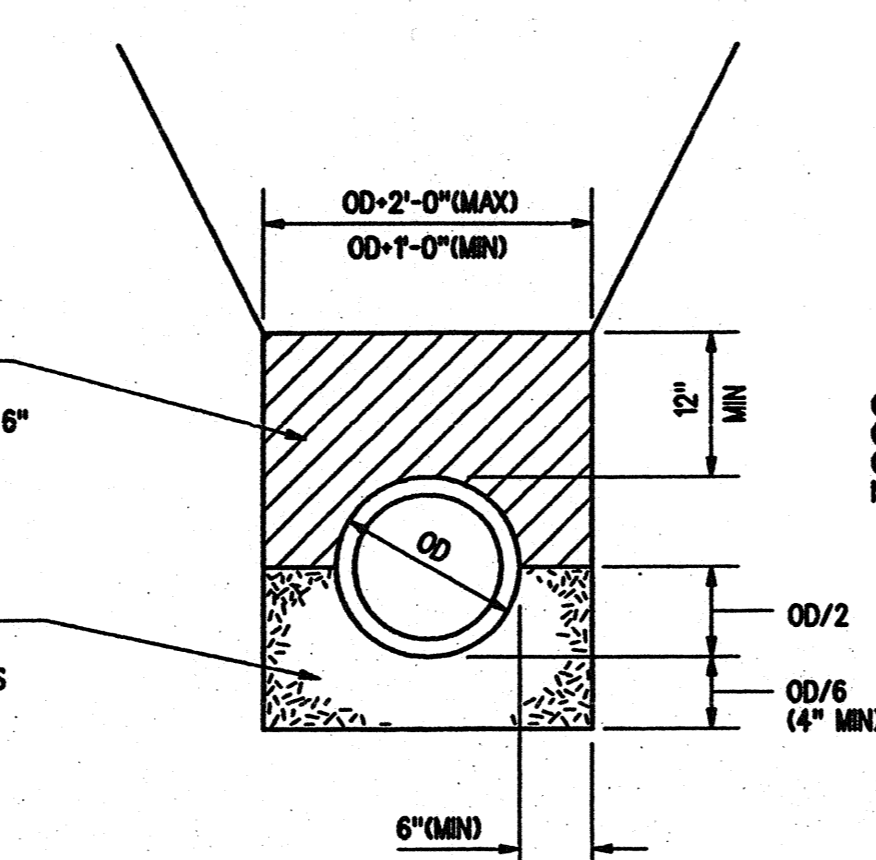
EB-1A
EB-1BTYPICAL TRANSFORMER SUMP DETAIL
WITH BASE PENETRATION

NOT TO SCALE

10

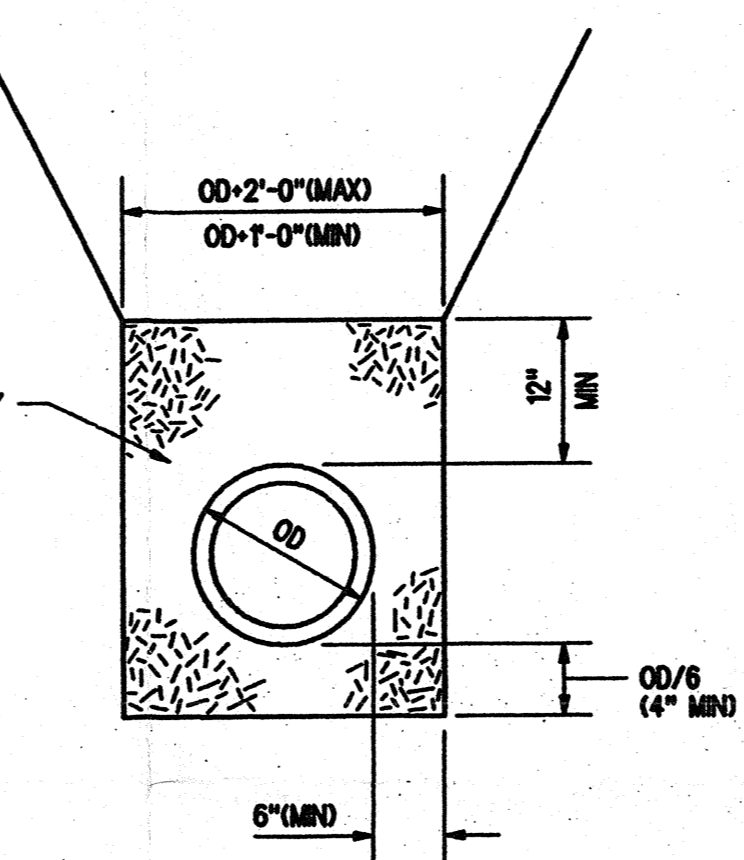
EB-1A
EB-1B

SELECT FILL MATERIAL
THOROUGHLY COMPACTED
IN LAYERS NOT EXCEEDING 6"

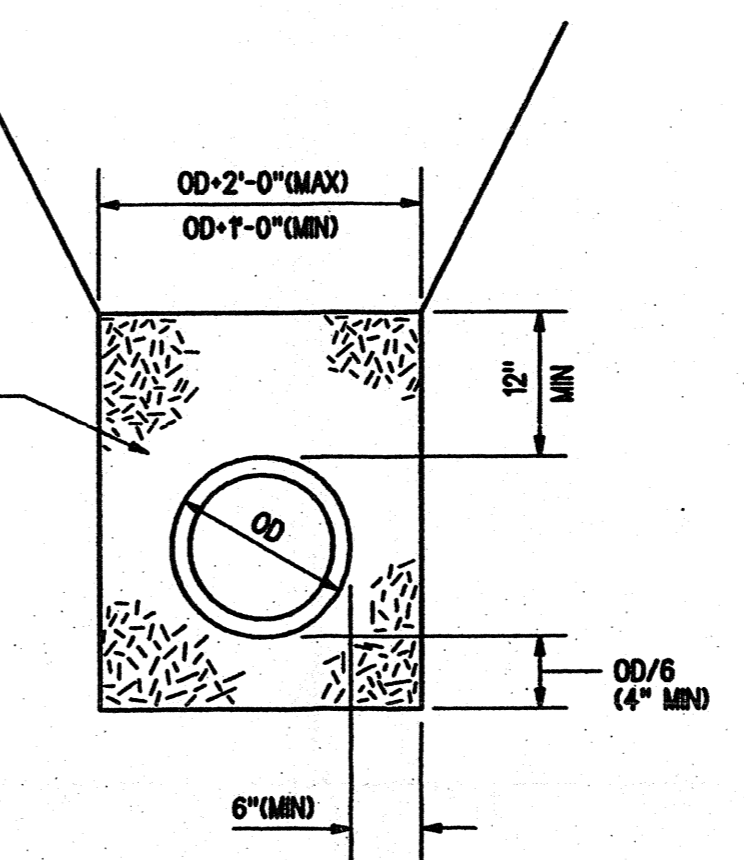


REINFORCED CONCRETE PIPE (RCP)

COARSE SAND UNIFORMLY
GRADED THOROUGHLY
COMPACTED IN LAYERS
NOT EXCEEDING 6"

CARBON STEEL (CS)
(COATED AND WRAPPED)

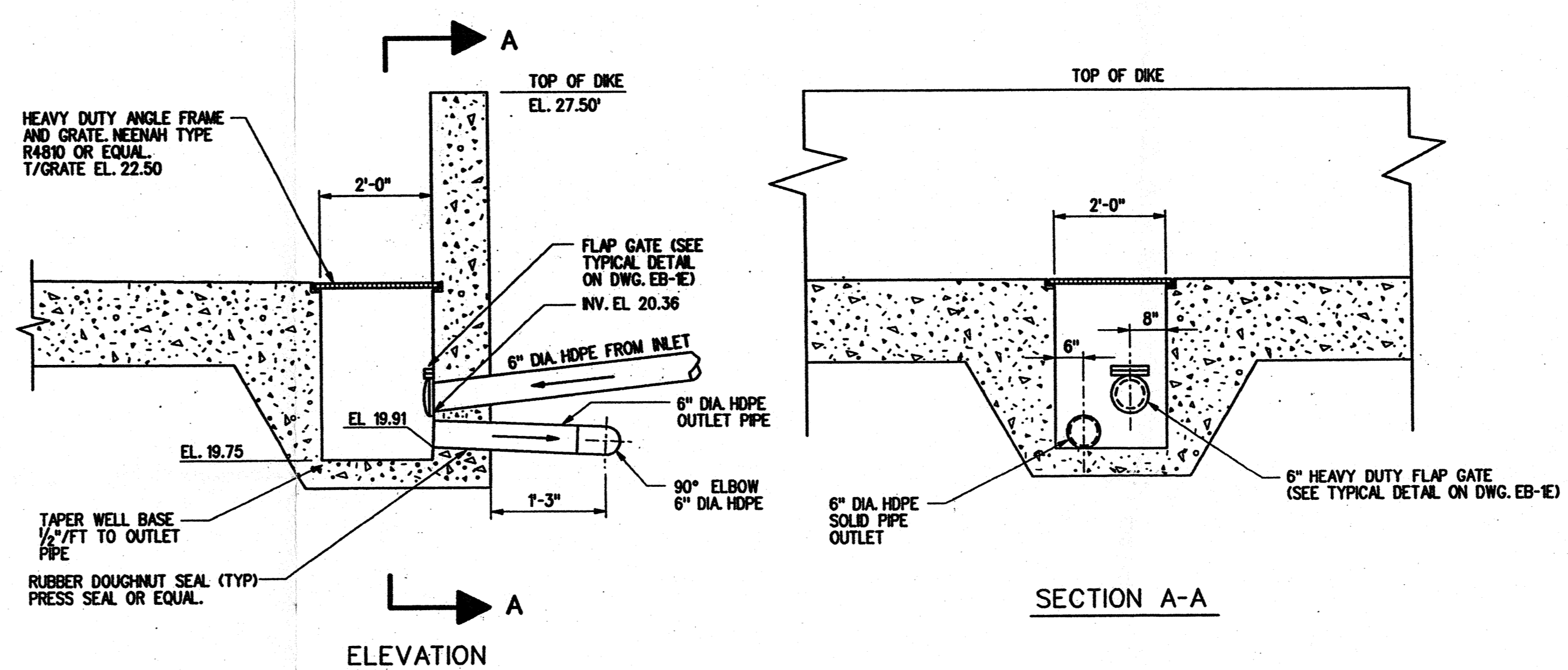
WELL GRADED GRANULAR MATERIAL
(ASTM C-33 GRADATION #57)
THOROUGHLY COMPACTED IN LAYERS
NOT EXCEEDING 6"

HIGH DENSITY POLYETHYLENE PIPE (SOLID WALL HDPE PIPE)
POLYVINYL CHLORIDE PIPE (PVC)

TYPICAL BEDDING DETAILS

NTS

2

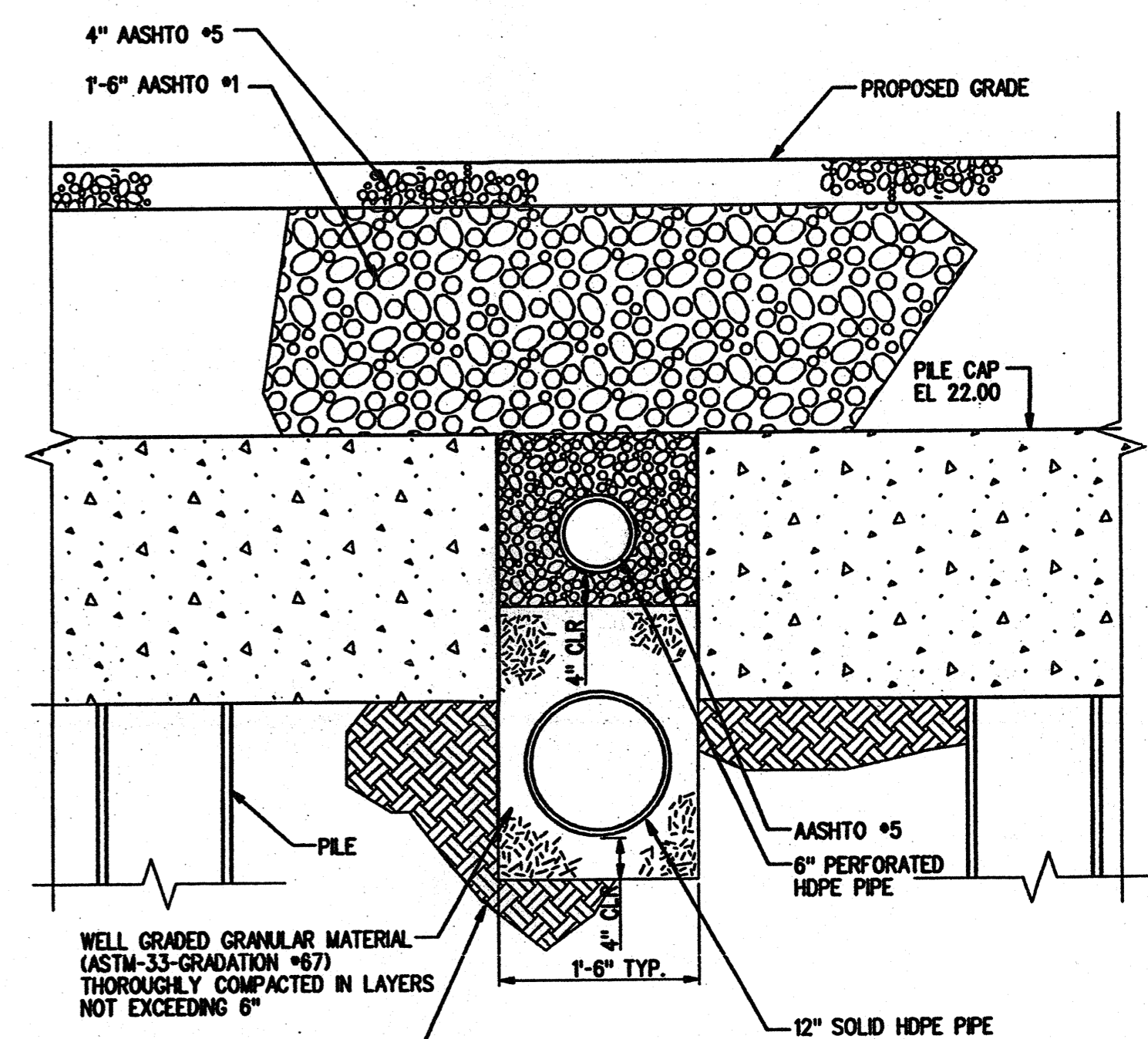
EB-1A
EB-1B
EB-1C

AMMONIA STORAGE AREA SUMP DETAIL

NOT TO SCALE

REFER TO DWG EC-22B FOR AMMONIA STORAGE PLAN & SECTION
NOTE: PIPE TO BE INSTALLED BEFORE POURING CONCRETE FOR DKE.

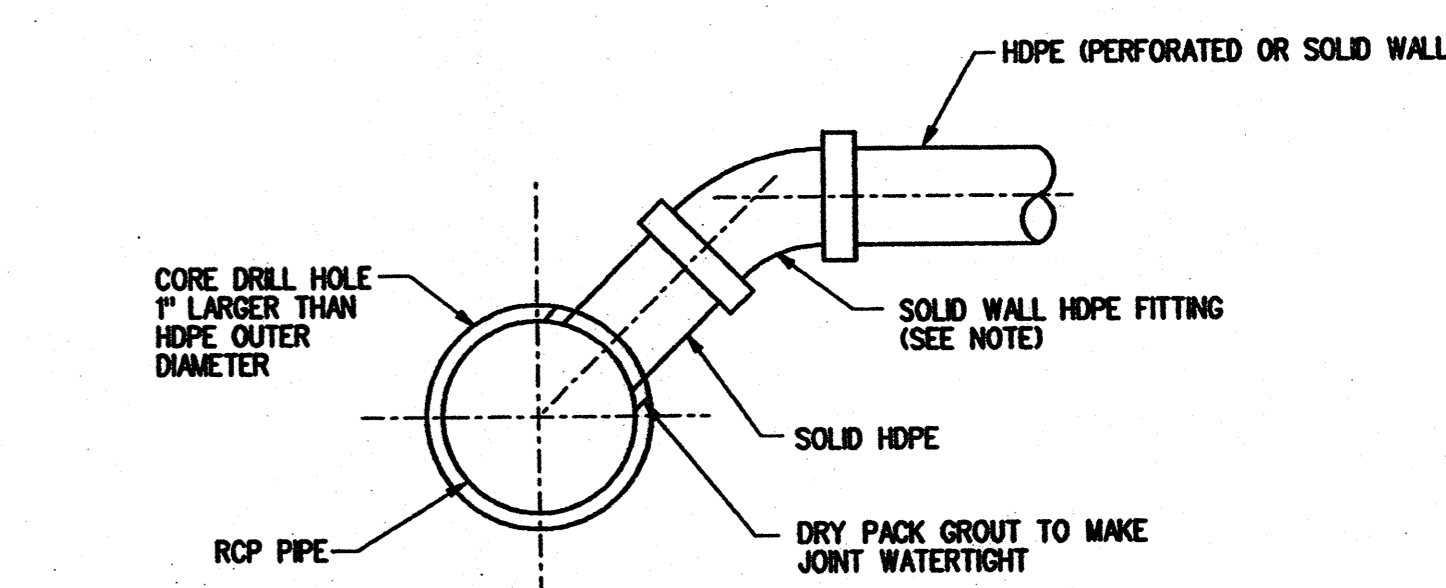
4

EB-1A
EB-1B
EB-1CTYPICAL SECTION FOR
HDPE DRAIN PIPE BETWEEN
AUX. BOILER FOUNDATIONS

NTS

A-A

EB-1A

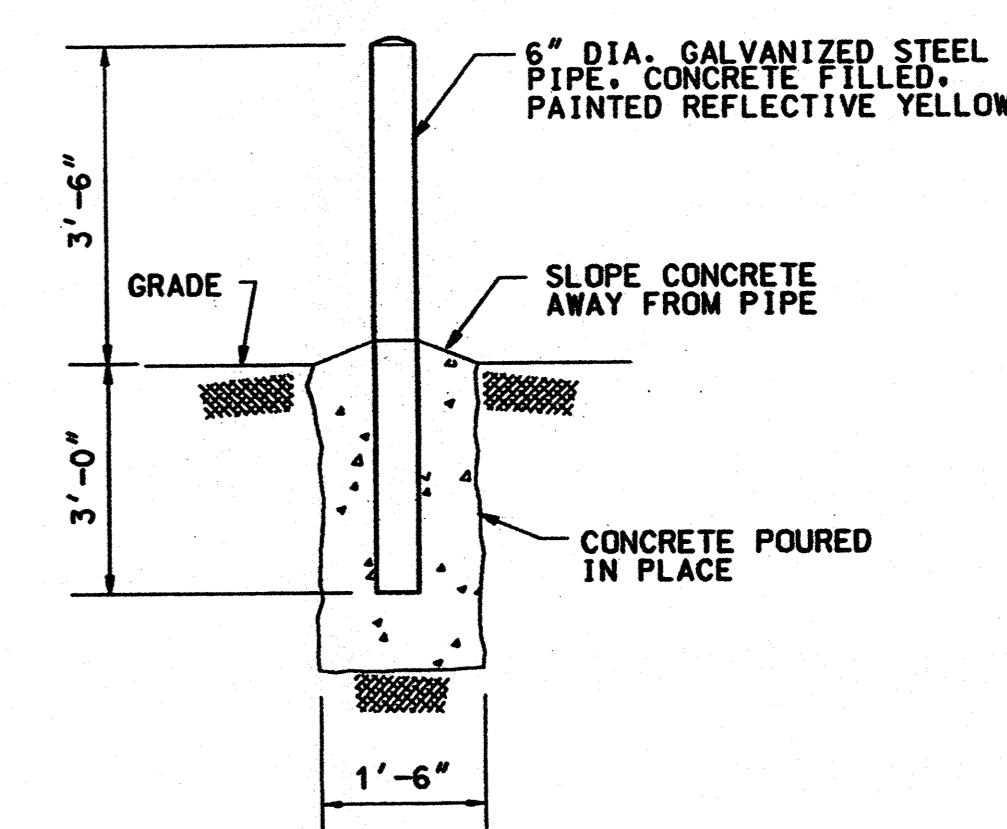


TYPICAL STORM WATER CONNECTION DETAIL

NOT TO SCALE

NOTE:
FITTING GEOMETRY MAY VARY BASED ON
PIPE GEOMETRY AND INVERTS

5

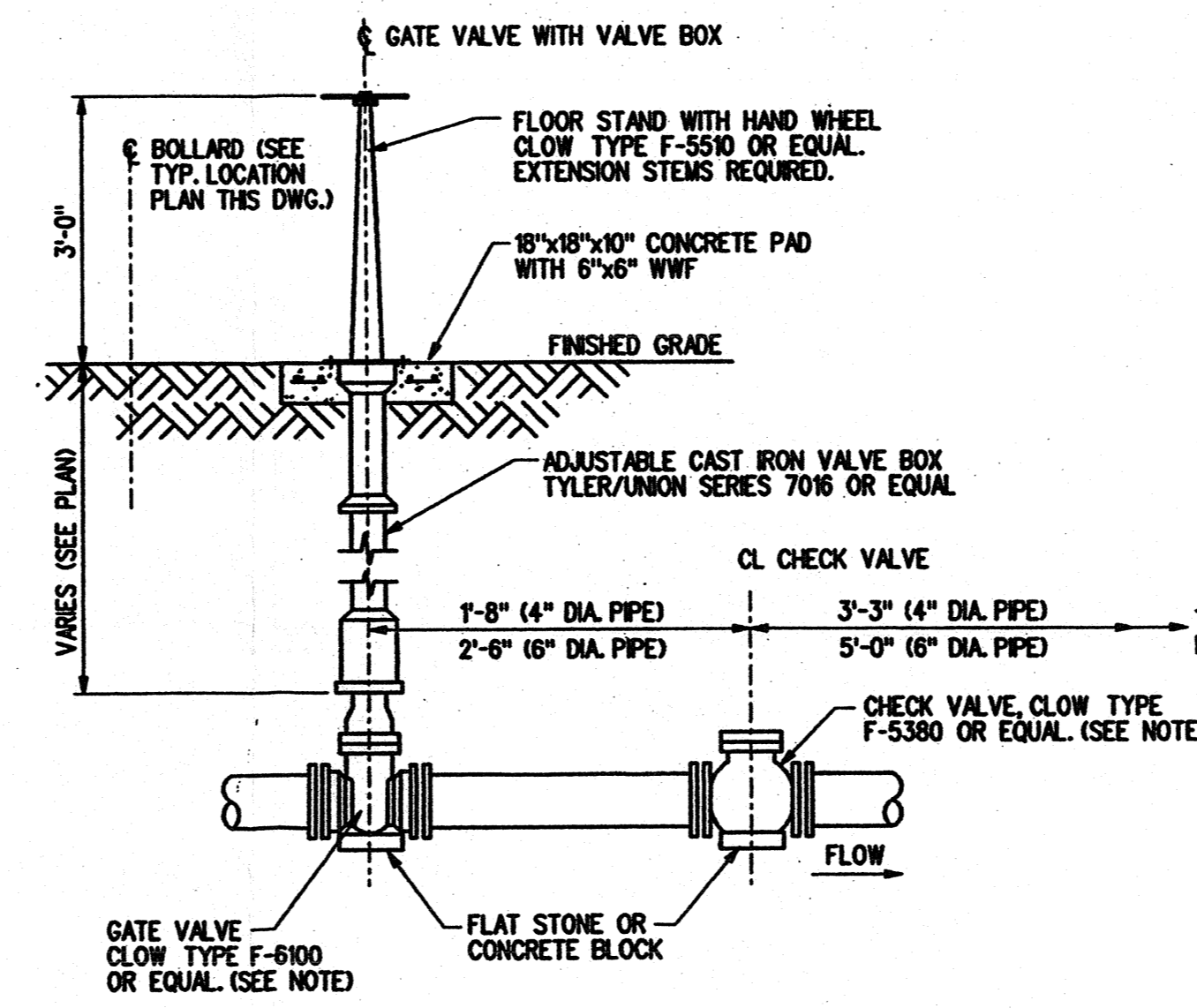
EB-1A
EB-1B
EB-1C
EB-1D

BOLLARD DETAIL

NOT TO SCALE

7

EB-1C

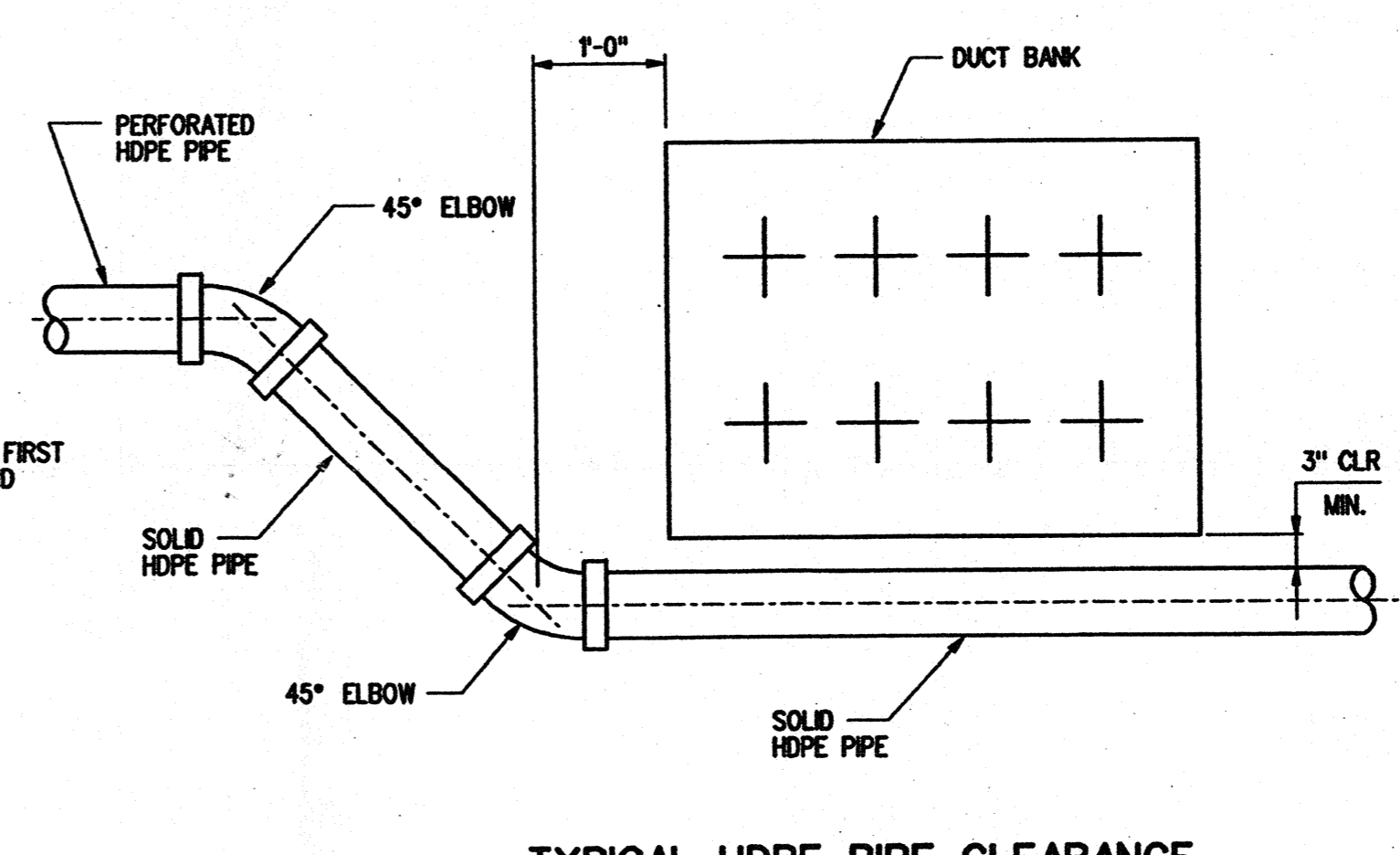


TYPICAL UNDERGROUND VALVE DETAIL

NOT TO SCALE

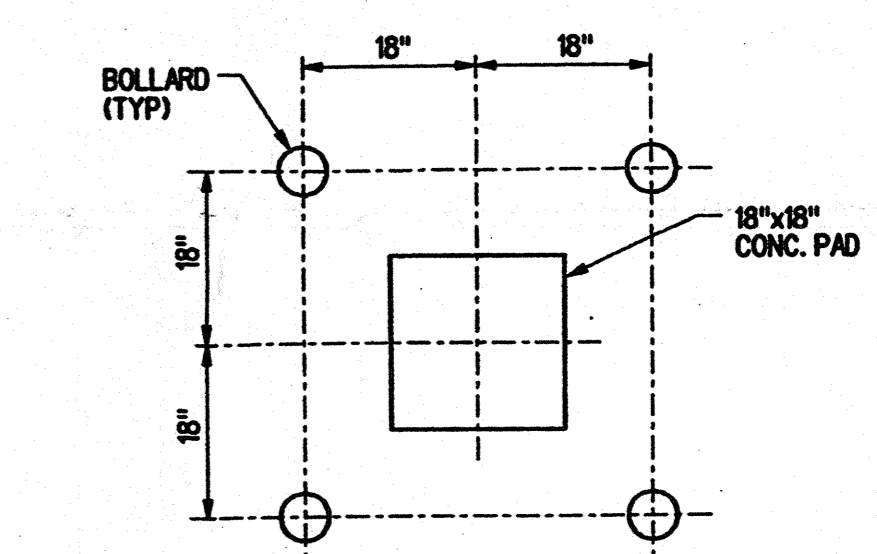
NOTE:
AMMONIA STORAGE AREA - 6\"/>

3

EB-1A
EB-1BTYPICAL HDPE PIPE CLEARANCE
AT DUCT BANK

NTS

8

EB-1A
EB-1B
EB-1C

TYPICAL BOLLARD LOCATION PLAN

NOT TO SCALE

NOTE: FOR LOCATIONS SEE DWGS. EB-1A, 1B, 1C & 1D.
FIELD SET AS REQUIRED.

ISSUE	DESCRIPTION	CHECKED	DATE	ISSUE	DESCRIPTION	CHECKED	DATE	ISSUE	DESCRIPTION	CHECKED	DATE	ISSUE	DESCRIPTION	CHECKED	DATE
1	AS BUILT	CP	12/20/01	2	REVISED AS NOTED AND ISSUED FOR CONSTRUCTION PHASE VI (WATER TREATMENT, AUX BOILER & ADMINISTRATION BLDG. AREAS)	CP	12/20/01	3	REVISED AS NOTED AND ISSUED FOR CONSTRUCTION PHASE VII	CP	12/20/01	4	ISSUED FOR CONSTRUCTION PHASE II	CP	12/20/01
5		CP	12/20/01	6		CP	12/20/01	7		CP	12/20/01	8		CP	12/20/01
9		CP	12/20/01	10		CP	12/20/01	11		CP	12/20/01	12		CP	12/20/01
13		CP	12/20/01	14		CP	12/20/01	15		CP	12/20/01	16		CP	12/20/01
17		CP	12/20/01	18		CP	12/20/01	19		CP	12/20/01	20		CP	12/20/01
21		CP	12/20/01	22		CP	12/20/01	23		CP	12/20/01	24		CP	12/20/01
25		CP	12/20/01	26		CP	12/20/01	27		CP	12/20/01	28		CP	12/20/01
29		CP	12/20/01	30		CP	12/20/01	31		CP	12/20/01	32		CP	12/20/01
33		CP	12/20/01	34		CP	12/20/01	35		CP	12/20/01	36		CP	12/20/01
37		CP	12/20/01	38		CP	12/20/01	39		CP	12/20/01	40		CP	12/20/01
41		CP	12/20/01	42		CP	12/20/01	43		CP	12/20/01	44		CP	12/20/01
45		CP	12/20/01	46		CP	12/20/01	47		CP	12/20/01	48		CP	12/20/01
49		CP	12/20/01	50		CP	12/20/01	51		CP	12/20/01	52		CP	12/20/01
53		CP	12/20/01	54		CP	12/20/01	55		CP	12/20/01	56		CP	12/20/01
57		CP	12/20/01	58		CP	12/20/01	59		CP	12/20/01	60		CP	12/20/01
61		CP	12/20/01	62		CP	12/20/01	63		CP	12/20/01	64		CP	12/20/01
65		CP	12/20/01	66		CP	12/20/01	67		CP	12/20/01	68		CP	12/20/01
69		CP	12/20/01	70		CP	12/20/01	71		CP	12/20/01	72		CP	12/20/01
73		CP	12/20/01	74		CP	12/20/01	75		CP	12/20/01	76		CP	12/20/01
77		CP	12/20/01	78		CP	12/20/01	79		CP	12/20/01	80		CP	12/20/01
81		CP	12/20/01	82		CP	12/20/01	83		CP	12/20/01	84		CP	12/20/01
85		CP	12/20/01	86		CP	12/20/01	87		CP	12/20/01	88		CP	12/20/01
89		CP	12/20/01	90		CP	12/20/01	91		CP	12/20/01	92		CP	12/20/01
93		CP	12/20/01	94		CP	12/20/01	95		CP	12/20/01	96		CP	12/20/01
97		CP	12/20/01	98		CP	12/20/01	99		CP	12/20/01	100		CP	12/20/01

STORM AND SANITARY
TYPICAL DETAILS

FPL ENERGY MARCUS HOOK L.P.
MARCUS HOOK, PENNSYLVANIA

STONE & WEBSTER, INC.
CHERRY HILL, NJ

DRAWING 13260-EB-1F-4
DESIGNED BY: TOP
DESIGN CHD BY: AR

DRAWN BY: MS
CHKD BY: AR

REVISIONS

DATE

BY

13260-EB-1F-4

Appendix L
Grantee's Amendment to Deed

008651

Thomson Judge C. M.
96 FEB 16 AM 10:13

Sun
2

GRANTEE'S AMENDMENT TO DEED



This Amendment to Deed, made the 14th day of FEBRUARY, in the year 1996, by Sun Company, Inc. (R&M), a Pennsylvania corporation (formerly Sun Refining and Marketing Company, a Pennsylvania corporation, formerly Sun Oil Company of Pennsylvania, a Pennsylvania corporation, successor by merger to Sun Oil Company, a New Jersey corporation), GRANTEE, with its principal place of business at 1801 Market Street, Philadelphia, PA 19103;

WHEREAS, GRANTEE has completed closure of a hazardous waste surface impoundment at its Marcus Hook Refinery pursuant to the U.S. Environmental Protection Agency hazardous waste regulations and Pennsylvania Department of Environmental Protection hazardous waste regulations, and in accordance with an approved closure plan;

WITNESSETH, That the following Deeds are hereby being amended:

- ①. Deed dated October 7, 1915 from The Estate of J. N. Pew to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 408, Page 19, at the Recorder of Deeds Office, Delaware County, Pennsylvania;
2. Deed dated October 11, 1937 from The Pure Oil Company to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 1040, Page 620, at the Recorder of Deeds Office, Delaware County, Pennsylvania;
3. Deed dated September 12, 1940, from The Pure Oil Company to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 1120, Page 267, at the Recorder of Deeds Office, Delaware County, Pennsylvania;
4. Deed dated December 29, 1941, from The Atlantic Refining Company to Sun Oil Company, a New Jersey corporation, recorded in Deed Book

EIGHT DEEDS REFERENCED HEREIN FORM A

PART OF FOLIO # 24-00-00303-00 (GREEN ST.)
OR FOLIO # 08-00-00782-00 (MARTIN ST.)

1178, page 406, at the Recorder of Deeds Office, Delaware County, Pennsylvania;

5. Deed dated September 8, 1944, from The Philadelphia, Baltimore and Washington Railroad to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 1234, Page 599, at the Recorder of Deeds Office, Delaware County, Pennsylvania;
6. Deed dated September 25, 1947, from The Pure Oil Company to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 1309, Page 484, at the Recorder of Deeds Office, Delaware County, Pennsylvania;
7. Deed dated May 20, 1958, from the United States of America to Sun Oil Company, a New Jersey corporation, recorded in Deed Book 1961, page 69, at the Recorder of Deeds Office, Delaware County, Pennsylvania; and
8. Deed dated September 15, 1995, from the Consolidated Rail Corporation to Sun Company, Inc. (R&M), a Pennsylvania corporation, recorded in Deed Book 1407, Page 856, at the Recorder of Deeds Office, Delaware County, Pennsylvania.

Pursuant to Section 265.119(b) of the U. S. Environmental Protection Agency Hazardous Waste Regulations (40 C.F.R. Part 265, Subpart G) and Section 265.119(b) of the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations (25 Pa. Code Chapter 265, Subchapter G), this Amendment is to provide the following notice to the Deeds listed above:

1. Land covered by to the aforementioned Deeds has been used to manage hazardous wastes;

2. The use of this land is restricted under the U. S. Environmental Protection Agency Hazardous Waste Regulations, 40 C.F.R. Part 265, Subpart G, and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.117(c); and
3. The survey plat and record of the type, location, and quantity of hazardous wastes disposed of within the hazardous waste disposal unit of the facility required by the U.S. Environmental Protection Agency Regulations, 40 C.F.R. 265.116 and 265.119(a), and the Pennsylvania Department of Environmental Protection Hazardous Waste Regulations, 25 Pa. Code 265.119(a), has been filed with the Marcus Hook Borough, the Lower Chichester Township, the Pennsylvania Department of Environmental Protection, and the U.S. Environmental Protection Agency.

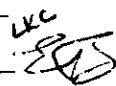
IN WITNESS WHEREOF, the GRANTEE has hereunto set its hand and seal the day and year first above written.

Sealed and Delivered

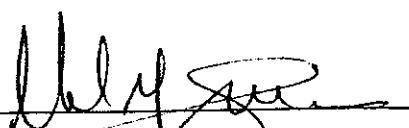
In the Presence of Us:



SUN COMPANY, INC. (R&M), Grantee

By: David E. Knell
Title: SENIOR VICE PRESIDENT ^{LLC} 

ATTEST:

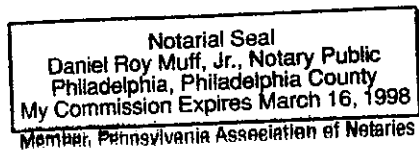
By: 
Title: ASSISTANT SECRETARY

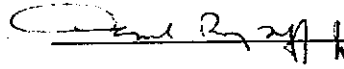
Commonwealth of Pennsylvania :

County of Philadelphia :

On this 14th day of FEBRUARY, 1996, before me personally appeared DAVID E. KNOLL who acknowledged himself (~~herself~~) to be the SENIOR VICE PRESIDENT of Sun Company, Inc. (R&M), a corporation, and that as such SENIOR VICE PRESIDENT, being authorized to do so, executed the foregoing instrument for the purposes therein contained by signing the name of the corporation by himself (~~herself~~) as SENIOR VICE PRESIDENT.

IN WITNESS WHEREOF, I have hereunto set my hand and official seal.




Notary Public.



Sun Company, Inc.
Ten Penn Center
1801 Market Street
Philadelphia PA 19103-1699
E. W. BAILEY

Sun Company, Inc.
1801 Market Street
Philadelphia, PA 19103-1699

Attn: E. W. Bailey / 22nd Floor